**SYLLABUS**

## Mathematical Analysis I
### (Differential calculus)

### 1.   Data about the program of study

| | | |
|---|---|---|
| 1.1 | Institution | Technical University of Cluj-Napoca |
| 1.2 | Faculty | Automation and Computer Science |
| 1.3 | Department | Mathematics |
| 1.4 | Field of study | Systems Engineering |
| 1.5 | Cycle of study | Bachelor of Science |
| 1.6 | Program of study/Qualification | Automation and Applied Informatics, English |
| 1.7 | Form of education | Full time |
| 1.8 | Subject code | 1.00 |

### 2.   Data about the subject

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|---|---|---|---|---|---|---|---|---|
| 2.1 | Subject name | | | Mathematical Analysis I (Differential Calculus) | | | | |
| 2.2 | Subject area | | | Mathematics | | | | |
| 2.3 | Course responsible/lecturer | | | Prof. dr. Dorian POPA | | | | |
| 2.4 | Teachers in charge of applications | | | Sl. dr. Alina RAMONA BAIAS | | | | |
| 2.5 | Year of study | I | 2.6 | Semester | 1 | 2.7 Assessment   exam | 2.8 Subject category | DF/OB |

### 3.   Estimated total time

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Number of hours per week | | 4 | 3.2 | of which, course | 2 | 3.3 applications | 2 |
| 3.4 | Total hours in the teaching plan | | 56 | 3.5 | of which, course | 28 | 3.6 applications | 28 |

| Individual study | Hours |
|---|---|
| Manual, lecture material and notes, bibliography | 18 |
| Supplementary study in the library, online and in the field | 15 |
| Preparation for seminars/laboratory works, homework, reports, portfolios, essays | 21 |
| Tutoring | 30 |
| Exams and tests | 3 |
| Other activities | 3 |

| | | |
|---|---|---|
| 3.7 | Total hours of individual study | 69 |
| 3.8 | Total hours per semester | 125 |
| 3.9 | Number of credit points | 5 |

### 4.   Pre-requisites (where appropriate)

| | | |
|---|---|---|
| 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)

| | | |
|---|---|---|
| 5.1 | For the course | |
| 5.2 | For the applications | |

### 6.   Specific competences

| | |
|---|---|
| Professional competences | **C1** – Operating with basic Mathematical, Engineering and Computer Science concepts<br>**C1.1** – Recognizing and describing concepts that are specific to the fields of calculability, complexity, programming paradigms, and modeling computational and communication systems<br>**C1.3** – Building models for various components of computing systems<br>**C1.5** – Providing a theoretical background for the characteristics of the designed systems |
| Cross competences | N/A |

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

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

**8. Contents**

| 8.1. Lecture (syllabus) | | Teaching methods | Notes |
|---|---|---|---|
| 1 | Real numbers. Sequences of real numbers. | Explanation | |
| 2 | Series of real numbers. Definition, examples and properties. | | |
| 3 | Tests of convergence for series of numbers.. | Demonstration | |
| 4 | Sequences of functions. Series of functions. Pointwise and uniform convergence. | | |
| 5 | Power series. Taylor formula and Taylor series. | Collaboration | |
| 6 | Trigonometric series. Fourier series. | | |
| 7 | Metric spaces. Sequences in metric spaces. | Interactive activities | |
| 8 | Topology of a metric space. Banach fixed point theorem. | | |
| 9. | Functions of several variables. Limit and continuity. | | |
| 10 | Partial derivatives. Differential operators. Differential of functions of several variables. Taylor's formula for functions of several variables. | | |
| 11 | Differential of functions of several variables. Taylor's formula for functions of several variables. | | |
| 12 | Extrema for functions of several variables. | | |
| 13 | Implicit functions. | | |
| 14. | Conditional extrema. | | |

Bibliography
1. Dorian Popa, Calculus – Mediamira Cluj-Napoca, 2006.
2. O. Stănăşilă, Analiză matematică, EDP Bucureşti, 1981
3. Dumitru Mircea Ivan. Calculus. Editura Mediamira, Cluj-Napoca, 2002.

| 8.2. Applications (Seminars) | | Teaching methods | Notes |
|---|---|---|---|
| 1 | Exercises related to sequences of numbers. | | |
| 2 | Exercises related to series. Sums of series. | | |
| 3 | Exercices related to the convergence of series with positive terms. | | |
| 4 | Exercices related to the convergence of series with general terms | Explanation | |
| 5 | Exercises concerning power series. | | |
| 6 | Exercises related to power series. | Demonstration | |
| 7 | Exercises related to Fourier series. | | |
| 8. | Exercises related to metric spaces and Banach Fixed Point Theorem. | Collaboration | |
| 9 | Functions of of several variables. Limit and continuity. | | |
| 10 | Partial derivatives and differential operators. | Interactive activities | |
| 11 | Derivative of a composite function. | | |
| 12 | Extrema for function of several variables. | | |
| 13 | Exercises related to implicit functions. | | |
| 14 | Exercises concerning conditional extrema. | | |

Bibliography
1. N. Vornicescu, D.M.Ivan, D. Popa, Calcul diferenţial, Editura Mediamira, 2004.

**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. |
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**10. Evaluation**

| Activity type | 10.1 | Assessment criteria | 10.2 | Assessment methods | 10.3 | Weight in the final grade |
|---|---|---|---|---|---|---|
| Course | | Abilities of understanding and using creatively the concepts and proofs | | Written examination | | 20% |
| Applications | | Abilities of solving problems and applying algorithms | | Evaluation during the semester and final written paper | | 80% |
| 10.4 Minimum standard of performance | | | | | | |
| Ability to present coherently a theoretical subject and to solve problems with practical content. | | | | | | |
| | | | | | | |

| Date of filling in:<br>21.03.2023 | | Title NAME | Signature |
|---|---|---|---|
| | Course | Prof. Dorian POPA | |
| | Applications | SL. dr. Alina-Ramona BAIAS | |

Date of approval by the Department Board

Head of Department of MATHEMATICS
Prof.dr. Dorian POPA

Date of approval by the Faculty Council

Dean
Prof.dr.ing. Liviu Cristian MICLEA

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