Academic course description

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| BACHELOR ‘S PROGRAMME1st YEAR OF STUDY, 2nd SEMESTER |

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| **Course title** | **Mathematical Analysis** |
| Course code |  |
| Course type | full attendance |
| Course level | 1st cycle (bachelor’s degree) |
| Year of study, semester | 1st year of study, 1st semester |
| Number of ECTS credits | 4 |
| Number of hours per week | 4 (2 lecture hours + 2 seminar hours) |
| Name of lecture holder | PhD Lecturer Adriana-Ioana Lefter |
| Name of seminar holder |  |
| Prerequisites | Advanced level of English  |
| A | **General and course-specific competences** |
|  | **General competences**:* Achievement of professional tasks efficiently and responsibly, in compliance with the field-specific deontology legislation, with qualified assistance.
* Application of efficient work techniques in a multi-disciplinary team, on various hierarchical levels.
* Effective use of information sources and communication resources and assisted professional training, both in Romanian and in a foreign language.

**Course-specific competences**:* C1. Identification and proper use of the main laws and physical principles in a given context.
* C 1.1 Derivation of working formulas for calculations with physical quantities using appropriate principles and laws of Physics.
* C 1.2 Description of physical systems, using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.)
* C 1.4 Correct application of methods of analysis and of criteria for choosing the appropriate solutions to achieve the specified performances.
* C3. Solving of Physics problems in given conditions, using numerical and statistical methods.
* C 3.1 Proper use of numerical methods and mathematical statistics in the analysis and processing of specific physical data
* C 3.2 Elaboration of graphs and reports for explaining and interpreting physical results obtained by statistical methods.
* C 3.3 Correlation of statistical analysis methods on a given topic (realization of measurements /calcu-lations, data processing, interpretation).
* C5. Communication and analysis of didactic, scientific and popularization of Physics-related information.
* C 5.1 Proper use in professional communication of the terminology specific to Physics but also to related domains (especially Mathematics)
* C 5.2 Presentation of scientific and popularization seminars on topics such as Atomic Physics, Nuclear and Elementary Particles Physics, Quantum Mechanics, Material Physics, Optics.
* C 5.3 Elaboration of reports and presentations, the construction of logical and coherent arguments, the support of these arguments in front of an informed audience, on subjects of General Physics.
* C 5.4 Critical assessment of a scientific communication, a paper/specialty report with a reduced degree of difficulty.
* C6. Interdisciplinary approach of Physics-related topics.
* C 6.1 Make of necessary connections to use physical phenomena, using basic knowledge from close domains (Chemistry, Biology, etc.)
* C 6.4 Making connections between knowledge of Physics and of other domains (Chemistry, Biology, Informatics, etc.).
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| B | **Learning outcomes** |
|  | * to compute limits of sequences of real numbers and of real functions
* to compute derivatives and partial derivatives;
* to operate with series of real numbers and series of functions;
* to compute Riemann, improper, line and multiple integrals.
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| C | **Lecture content** |
|  | Sequences of real numbers: bounded sequences, monotone sequences, convergent sequences, subsequences of a sequence; properties of convergent sequences; the squeeze theorem; Cesarò’s lemma; the Stolz-Cesarò theoremSeries of real numbers: convergent series, properties, algebraic operations; convergence tests; absolutely convergent series Limits and continuity for real functions: definitions, lateral limits; elementary functions and fundamental limitsDerivative and differential of a real function, interpretation of the derivative; Rolle’s theorem, Lagrange’s theorem, Cauchy’s theorem; studying the monotony of a function using the derivative; extremum points; higher order derivatives and differentials; Taylor’s formula; l’Hospital’s ruleIndefinite integrals: antiderivatives, properties, integration methods, antiderivatives of elementary and composite functions Riemann integral: Leibniz-Newton formula, integration by parts, integration by substitutionImproper integrals; convergence tests Sequences and series of functions, pointwise and uniform convergence; uniform convergence criteria for series of functions; term by term integration and differentiation. Power series and trigonometric series Functions of several real variables: limits, continuity, partial derivatives; the differential of a multivariable function; vector valued functions and the jacobian matrix; partial derivatives and differentials of higher order, the hessian matrix; Schwarz criterion; Taylor’s formula; extremum pointsLine integrals of the first and second kindMultiple integralsSurface integrals; Stokes’ formula, Green’s formula |
| D | **Recommended reading for lectures** |
|  | 1. Tom M. Apostol, Calculus, vol. 1, 2, 2nd edition, John Wiley & Sons, 1967.2. W. Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw-Hill Inc., 1976.3. G. Strang, Calculus, Wellesley-Cambridge Press, 1991. |
| E | **Seminar content** |
|  | Sequences of real numbers: bounded sequences, monotone sequences, convergent sequences, subsequences of a sequence. Properties of convergent sequences; the squeeze theorem; Stolz-Cesarò theoremSeries of real numbers: convergent series, properties, algebraic operations; convergence tests; absolutely convergent series Limits and continuity for real functions; lateral limits; elementary functions and fundamental limitsDifferentiability of real functions; l’Hospital’s rule Indefinite integrals: antiderivatives, properties, integration methods, antiderivatives of elementary and composite functions Riemann integral: Leibniz-Newton formula, integration by parts, integration by substitutionImproper integrals; convergence tests Power series and trigonometric seriesFunctions of several real variables: limits, continuity, partial derivatives, extremum points Line integrals of the first and second kindMultiple integralsSurface integrals |
| F | **Recommended reading for seminars** |
|  | 1. Tom M. Apostol, Calculus, vol. 1, 2, 2nd edition, John Wiley & Sons, 1967.2. W. Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw-Hill Inc., 1976.3. G. Strang, Calculus, Wellesley-Cambridge Press, 1991. |
| G | **Education style** |
| learning and teaching methods | Lecture, didactic explanation, heuristic conversation, video projection, problem solving method, case studies |
| assessment methods | * Written assignment
* Oral assessment, systematic observation of the activity at the seminar
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| Language of instruction | English |