BACHELOR 'S PROGRAMME
1st 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.).

**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.

**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 theorem
Series 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 limits

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| | Derivative 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 rule<br>Indefinite integrals: antiderivatives, properties, integration methods, antiderivatives of elementary and composite functions<br>Riemann integral: Leibniz-Newton formula, integration by parts, integration by substitution<br>Improper integrals; convergence tests<br>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<br>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 points<br>Line integrals of the first and second kind<br>Multiple integrals<br>Surface 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.<br>2. W. Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw-Hill Inc., 1976.<br>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 theorem<br>Series of real numbers: convergent series, properties, algebraic operations; convergence tests; absolutely convergent series<br>Limits and continuity for real functions; lateral limits; elementary functions and fundamental limits<br>Differentiability of real functions; l'Hospital's rule<br>Indefinite integrals: antiderivatives, properties, integration methods, antiderivatives of elementary and composite functions<br>Riemann integral: Leibniz-Newton formula, integration by parts, integration by substitution<br>Improper integrals; convergence tests<br>Power series and trigonometric series<br>Functions of several real variables: limits, continuity, partial derivatives, extremum points<br>Line integrals of the first and second kind<br>Multiple integrals<br>Surface integrals |
| F | RECOMMENDED READING FOR SEMINARS |
| | 1. Tom M. Apostol, Calculus, vol. 1, 2, 2nd edition, John Wiley & Sons, 1967.<br>2. W. Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw-Hill Inc., 1976.<br>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<br>• Oral assessment, systematic observation of the activity at the seminar |
| LANGUAGE OF INSTRUCTION | English |