

SYLLABUS

1. Data about the program of study

| | | |
|-----|--------------------------------|---|
| 1.1 | Institution | The Technical University of Cluj-Napoca |
| 1.2 | Faculty | Faculty of Civil Engineering |
| 1.3 | Department | Mecanica constructiilor |
| 1.4 | Field of study | Civil Engineering |
| 1.5 | Cycle of study | Bachelor of Science |
| 1.6 | Program of study/Qualification | Civil, Industrial and Agricultural Buildings /Engineer (English language) |
| 1.7 | Form of education | Full time |
| 1.8 | Subject code | 2.0 |

2. Data about the subject

| | | | | | | | | | | | |
|-----|--------------------------------|---|-----|----------|--|-----|------------|---|-----|------------------|-------|
| 2.1 | Subject name | | | | Algebra liniara, geometrie analitica si differentiale | | | | | | |
| 2.2 | Course responsible/lecturer | | | | Conf.Dr.Mat. Ovidiu Furdui- Ovidiu.Furdui@math.utcluj.ro | | | | | | |
| 2.3 | Teachers in charge of seminars | | | | Conf.Dr.Mat. Ovidiu Furdui- Ovidiu.Furdui@math.utcluj.ro | | | | | | |
| 2.4 | Year of study | 1 | 2.5 | Semester | 1 | 2.6 | Assessment | E | 2.7 | Subject category | DF/DI |

3. Estimated total time

| | | | | | |
|--|---------------------------------|-----------------------|----|-------------------|-------|
| 3.1 Number of hours per week | 4 | 3.2 of which, course: | 2 | 3.3 applications: | |
| 3.4 Total hours in the curriculum | 56 | 3.5 of which, course: | 28 | 3.6 applications: | |
| Individual study | | | | | hours |
| Manual, lecture material and notes, bibliography | | | | | 28 |
| Supplementary study in the library, online and in the field | | | | | 4 |
| Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | 2 |
| Tutoring | | | | | 2 |
| Exams and tests | | | | | 2 |
| Other activities | | | | | 0 |
| 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 | Derivatives and integrals, systems of linear equations, determinants and matrices. |
| 4.2 | Competence | Derivatives and integrals, systems of linear equations, determinants and matrices. |

5. Requirements (where appropriate)

| | | |
|-----|----------------|---|
| 5.1 | For the course | "- to use linear algebra as a tool in investigating problems from other domains, in particular, in differential geometry - recognize the different types of tangency (planes and lines), |
|-----|----------------|---|

| | | |
|-----|----------------------|---|
| | | normals - calculate the length of segments, arcs and the area of surfaces" |
| 5.2 | For the applications | - to use linear algebra as a tool in investigating problems from other domains, in particular, in differential geometry - recognize the different types of tangency (planes and lines), normals - calculate the length of segments, arcs and the area of surfaces |

6. Specific competences

| | |
|--------------------------|--|
| Professional competences | Knowledge of research methods in the field of linear algebra and matrix theory and their applications to engineering problems. |
| Cross competences | - |

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

| | | |
|-----|---------------------|--|
| 7.1 | General objective | Knowledge of linear algebra problems with application in practice. |
| 7.2 | Specific objectives | Knowledge of linear algebra problems with application in practice. Applications of matrices theory for solving engineering problems. |

8. Contents

| 8.1. Lecture (syllabus) | Teaching methods | Notes |
|--|------------------|-------|
| Real functions of one real variable: differential calculus, definition of the derivative, geometric meaning of the derivative, properties | - | - |
| Real functions of several real variables: definition and properties of partial derivatives of order one and of higher order, Schwarz theorem, differential of a function | | |
| Differentiation of composite functions: exposure of various cases, deduction of the formulas for derivatives of order one and two | | |
| Local extrema: Taylor's formula for functions of several real variables, definition of local extrema, critical points, algorithms to determine the local extrema | | |
| Implicit functions: definition, existence theorem, derivatives of the implicit functions | | |
| Differential operators: gradient, divergence, laplacean, curl operator, jacobian | | |

| | | |
|--|------------------|-------|
| Changes of variables in differential expressions | | |
| Definite integrals : definition, geometric meaning, integration by parts, changes of variables | | |
| Line integrals with respect to arc length: definition, method of calculus, applications | | |
| Line integrals with respect to coordinates : definition, method of calculus, applications, path independence | | |
| Double integrals: definition, calculus by iteration, examples | | |
| Changes of variables in double integrals: general formula, the particular case of polar coordinates | | |
| Applications of double integrals: calculus of area, mass, mass center, inertia momentum | | |
| Triple integrals: definition, calculus by iteration, change of | | |
| Bibliography | | |
| Bibliography | | |
| 1. D. Inoan, Elemente de calcul integral, Ed. UTPres Cluj-Napoca, Cluj-Napoca, 2006 2. M. Ivan, Calculus, Ed. Mediamira, 2002 3. V. Mureşan, Analiză matematică, Casa de editură Transilvania Press, Cluj-Napoca, 2000. 4. M. Nikolsky, A course of Mathematical Analysis, vol.I, MIR, 1990. | | |
| 8.2. Applications/Seminars | Teaching methods | Notes |
| Derivatives and partial derivatives of first and second order: exercises | | |
| Partial derivatives of composite functions: exercises | | |
| Local extrema for functions of two variables: exercises | | |
| Derivatives of implicit functions: exercises | | |
| Applications of calculus in physical sciences: exercises | | |
| Differential operators: exercises | | |
| Riemann integrals on a real interval: exercises | - | - |
| Improper integral | | |
| Line integrals: exercises | | |
| Applications of line integrals: exercises | | |
| Double integrals: definition, calculus by iteration, examples | | |
| Applications of double integrals: exercises | | |
| Applications of triple integrals: exercises | | |
| Surface integrals | | |
| Bibliography | | |
| Bibliography | | |
| 1. D. Inoan, Problems in differential and integral calculus, Ed. Mediamira, Cluj-Napoca, 20072. N. Vornicescu, colectiv, Calcul diferencial, Ed. Mediamira, 20043. D. Inoan, A.Novac, D. Popa, Probleme de analiza matematica, Ed. Mega, 20114. D. Marian, Mathematical Analysis, Ed. Mega, 2012 | | |

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

Mathematical contents with a large applicability in technical and engineering sciences are included.

10. Evaluation

| | | | |
|---------------|--------------------------|-------------------------|--------------------------------|
| Activity type | 10.1 Assessment criteria | 10.2 Assessment methods | 10.3 Weight in the final grade |
|---------------|--------------------------|-------------------------|--------------------------------|

| | | | |
|--|---|--|--|
| 10.4 Course | Knowledge of notions and properties specific to differential calculus and integral calculus. | Theoretical questions (written paper) | Theoretical questions (written paper) |
| 10.5 Applications | Capacity of solving problems and applications of mathematical analysis, differential and integral calculus. | Solving exercises and problems (written paper) | Solving exercises and problems (written paper) |
| 10.6 Minimum standard of performance | | | |
| Solving at least 40% of the proposed subjects. | | | |

| Date of filling in: | | Title Surname Name | Signature |
|---------------------|-----------------------------------|----------------------------|-----------|
| | Lecturer | Conf.Dr.Mat. Ovidiu Furdui | |
| | Teachers in charge of application | Conf.Dr.Mat. Ovidiu Furdui | |

| | |
|--|---|
| Date of approval in the department | Head of department conf.dr.ing. Anca-Gabriela POPA |
| 19/06/2025 | |
| Date of approval in the faculty | Dean prof.dr.ing Daniela MANEA |
| 25/06/2025 | |