COURSE SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Road Vehicles, Mechatronics and Mechanics
1.3 Department	Department of Mechatronics and Machine Dynamics
1.4 Field of study	Mechatronics
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Mechatronics (In English Language)-Lic
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	Mathematical Analysis			Subject code	1.00
2.2 Course responsible/lecturer	Conf. Dr. Daniela Marian daniela.marian@math.utcluj.ro				
2.3 Teacher in charge of seminars/labs/projects	Conf. Dr. Daniela Marian daniela.marian@math.utcluj.ro				
2.4 Year of study	I	2.5 Semester	I	2.6 Assessment	E
2.7 Subject category	Formative category				DOF
	Optional				DOB

3. Estimated total time

3.1 Number of hours per week	2	of which:	3.2 Course	2	3.3 Seminar	2	3.3 Laboratory	-	3.3 Project	-	3.3 Practical traininh	-
3.4 Number of hours per semester	2	of which:	3.5 Course	28	3.6 Seminar	28	3.6 Laboratory	-	3.6 Project	-	3.3 Practical training	-

3.7 Distribution of time allocation (hours per semester) for individual study and assessment:	
(a) Assessment	3
(b) Study of textbooks, course materials, bibliography, and lecture notes	20
(c) Additional research in the library, on specialized electronic platforms, and in the field	11
(d) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	10
(e) Tutoring	
(f) Other activities	
3.8 Total hours for individual study and evaluation (sum (3.7(a)…3.7(f))	44
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credit points	4

4. Pre-requisites (if applicable)

4.1 Curriculum	
4.2 Competence	

5. Requirements (if applicable)

5.1. for the course	N/A Electronic Course	
5.2. for the seminar/lab/project	Individual work	

6. Subject-specific learning outcomes

Professional competencies	• C1. Advanced knowledge in control systems and robotics technologies, which prepares them to work in the industrial and service sectors. • C2. Practical skills in the design, development and integration of robots and robotic systems, through which graduates will be able to develop customized solutions for industrial robotics problems. • C3. Advanced knowledge in programming, including Matlab, which helps them understand and develop the software needed to control robots and robotic systems. • C4. Essential technical skills in the electrical, control, mechanical and industrial fields, such as knowledge of the principles of electronics, data acquisition, design and construction of mechanical and electrical components and other devices used in robots. • C5. Teamwork and communication skills with professionals from various fields, such as computer science, engineering and mechatronics, to collaborate in the development of complex robotic solutions. • C6. Knowledge of the latest technologies, including artificial intelligence, virtual reality, human-robot interaction, mechatronic systems, digital manufacturing and the industrial internet of things, which helps them stay abreast of new trends and develop cutting-edge robotic solutions. • C7. Ability to make informed and technical decisions to develop innovative and customized solutions to robotics problems. • C8. Ability to work independently and find solutions to complex robotics problems.
Transversal competencies	• Teamwork skills: The Robotics study program (in Cluj-Napoca) places a strong emphasis on developing collaboration and teamwork skills, necessary to address complex problems in the field. • CT2. Communication skills: Graduates of this program are prepared to communicate effectively with professionals from various fields, as well as with the general public, especially when it comes to presenting and presenting complex technical projects and solutions. • CT3. Critical and analytical thinking: The study program develops critical and analytical thinking skills, necessary to understand and solve complex problems in the field of robotics. • CT4. Adaptability: Students learn to be flexible, able to adapt to new technologies, methods and tools, as well as to changes in the industry and the demands of the labor market. This competence is crucial in a field that is rapidly evolving and constantly changing.

7. Expected learning outcomes

Knowledge	Upon completion of the study program, the graduate knows and understands: RI1. The mathematical foundations are necessary for the description, modeling and analysis of robotic, mechatronic and assisted manufacturing systems. RI4. Principles of computer-aided design for parts, assemblies and robotic systems, including parametric modeling, CAD integration and constructive design of industrial robots. RI5. Fundamentals of programming and software development for robotics, including the use of languages and environments relevant for engineering applications, automation, control, communications and digital integration. RI7. Principles of artificial intelligence, human-robot interaction, industrial connectivity, the Internet of Things in industry and the digital transformation of production processes.

Skills	Upon completion of the study program, the graduate can: RI11. Use mathematical, numerical and computational tools to model, analyze and solve engineering problems specific to robotics. RI13. Develop and implement software applications for control, simulation, programming and integration of robotic equipment and industrial peripherals. RI17. Use artificial intelligence technologies, sensory systems and simulation methods to improve the behavior, autonomy and performance of robotic systems. RI20. Develop technical documentation, engineering projects, experimental reports and professional presentations for solutions in the field of robotics.
Responsibility and autonomy	Upon completion of the study program, the graduate can act with responsibility and autonomy as follows: RI21. Assumes the performance of professional tasks specific to the development, integration and exploitation of robotic systems, in compliance with technical, quality, security and professional ethics requirements. RI23. Makes reasoned technical decisions in choosing architectures, components, control methods and integration solutions for robotic applications. RI24. Autonomously manages analysis, design, implementation, testing and improvement activities of medium-complexity robotic solutions. RI26. Demonstrates concern for continuous learning, professional updating and adaptation to the accelerated evolution of robotics, artificial intelligence and digital production technologies. RI27. Respects the norms of academic and professional integrity, as well as the requirements regarding documentation, traceability and responsible use of digital technologies. RI28. Can develop and support an integrative diploma project, demonstrating the ability to transform an engineering topic into a coherent, well-argued and technically validated solution.

8. Discipline objectives (derived from the specific competencies grid)

8.1 General objective of the discipline	• preparing students to become experts in the design, development and use of robots and robotic systems, using mathematical analysis
8.2 Specific objectives	• Development of technical skills in key areas of robotics, such as the use of mathematics. Development of competences in the field of mathematical analysis in support of professional training. Assimilation of theoretical knowledge related to the differential and integral calculus of functions of several variables . -Acquiring skills for their application in practice -Applying the rules of derivation -Calculating partial derivatives of real functions of several real variables - Calculating the differential of real functions of several real variables -Writing Taylor's formula for real functions of several variables -Studying the extrema of functions of several variables - Calculating improper integrals - Calculating double integrals, curvilinear integrals -Applying the results learned in other areas

9. Contents

9.1 Course	No. of hours	Teaching methods	Notes
1. Real functions of one real variable. Limits. Continuity	2		
2. Differential calculus of real functions of a real variable. Problems that led to the concept of derivative (determining the tangent line to the graph of a function, velocity). Definition. Properties. Applications. Higher-order derivatives.	2		
3. Real functions of a real variable: Monotonicity; Convexity/concavity; Taylor's formula; Approximations. Errors. Differential; Extrema.	2		
4. Differential calculus of real functions of several variables (two or three). Partial derivatives. Higher-order partial derivatives. Derivatives of composite functions (Chain rule). Homogeneous functions. Directional derivative. Differential. Higher-order differential.	2		
5. Differential calculus of real functions of several variables (two or three). Jacobian matrix. Extrema.	2		
6. Taylor's formula for functions of several variables (two or three). Differential operators.	2	Oral presentation, notes on blackboard and multimedia presentation. Students are asked and encouraged to ask questions.	
7. Differential calculus of vector-valued functions of a vector variable. Parametric curves.	2		
8. Antiderivatives. Properties. Changes of variables. Integration by parts.	2		
9. Definite integral. Properties. Changes of variables. Integration by parts. Applications. Improper integrals. Integrals depending on a parameter.	2		
10. The length of a curve. Line integrals with respect to arc length (Line integrals of the first kind).	2		
11. Line Integrals with Respect to Coordinates. Line Integrals Path Independent. Applications of Line Integrals	2		
12. Double Integrals. Calculus by Iteration. Green–Riemann formula	2		
13. Change of variables in double integrals. Applications of double integrals.	2		
14. Triple integral. Calculation of triple integrals by iteration. Applications of Triple Integrals.	2		

Bibliography

1. D. Inoan, Problems in differential and integral calculus, Mediamira, Cluj-Napoca, 2007
2. M. Ivan, Calculus, Ed. Mediamira, Cluj-Napoca, 2002
3. D. Marian, Mathematical Analysis, Ed. Mega, 2012
4. *J. Stewart, Calculus, 8th ed. Boston, MA, USA: Cengage Learning, 2016,* https://www.mymathscloud.com/api/download/modules/AP-Calculus/Textbooks/Calculus%20Stewart.pdf?id=149258416

9.2 Seminar / laboratory / project / practical training	No. of hours	Teaching methods	Notes
1. Real functions of one real variable. Limits. Continuity - Applications	2		
2. Differential calculus of real functions of a real variable. Problems that led to the concept of derivative (determining the tangent line to the graph of a function, velocity). Definition. Properties. Applications. Higher-order derivatives. -Applications	2		
3. Real functions of a real variable: Monotonicity; Convexity/concavity; Taylor's formula; Approximations. Errors. Differential; Extrema. -Applications	2		
4. Differential calculus of real functions of several variables (two or three). Partial derivatives. Higher-order partial derivatives. Derivatives of composite functions (Chain rule). Homogeneous functions. Directional derivative. Differential. Higher-order differential. -Applications	2		
5. Differential calculus of real functions of several variables (two or three). Jacobian matrix. Extrema. -Applications	2		
6. Taylor's formula for functions of several variables (two or three). Differential operators. -Applications	2		
7. Differential calculus of vector-valued functions of a vector variable. Parametric curves. -Applications	2		
8. Antiderivatives. Properties. Changes of variables. Integration by parts. -Applications	2		
9. Definite integral. Properties. Changes of variables. Integration by parts. Applications. Improper integrals. Integrals depending on a parameter. -Applications	2	Practical problems Students are asked and encouraged to ask questions	
10. The length of a curve. Line integrals with respect to arc length (Line integrals of the first kind). -Applications	2		
11. Line Integrals with Respect to Coordinates. Line Integrals Path Independent. Applications of Line Integrals-Applications	2		
12. Double Integrals. Calculus by Iteration. Green–Riemann formula-Applications	2		
13. Change of variables in double integrals. Applications of double integrals. -Applications	2		
14. Triple integral. Calculation of triple integrals by iteration. Applications of Triple Integrals. -Applications	2		

Bibliography

5. D. Inoan, Problems in differential and integral calculus, Mediamira, Cluj-Napoca, 2007
6. M. Ivan, Calculus, Ed. Mediamira, Cluj-Napoca, 2002
7. D. Marian, Mathematical Analysis, Ed. Mega, 2012
8. *J. Stewart, Calculus, 8th ed. Boston, MA, USA: Cengage Learning, 2016,* https://www.mymathscloud.com/api/download/modules/AP-Calculus/Textbooks/Calculus%20Stewart.pdf?id=149258416

9.2 Seminar / laboratory / project / practical training	No. of hours	Teaching methods	Notes

10. Corroborating the course contents with the expectations of the epistemic community, professional associations, and representative employers in the field related to the program

11. Evaluation

Type of activity	11.1 Assessment criteria	11.2 Assessment methods (and type of assessment: continuous/summative)	11.3 Weight in the final grade
11.4 Course	The ability to answer to theoretical questions and to solve practical problems	Written / oral exam, marked with E (contains theoretical aspects, problems)	E is 80%
11.5 Seminar/Laboratory /Project / Practical training	The activity during classes is appreciated	Questions on each class. Activity of seminar+Test (mark AS) Homework (mark H)	AS is 10% H is 10%
11.6 Minimum performance standard N≥5; N=0,8 E+0,1AS+0,1H			

Completion date:	Faculty members	academic rank, title, First Name SURNAME	Signature
20.05.2026	Course	Conf. Dr. Daniela Marian	
	Practical activities	Conf. Dr. Daniela Marian	

Approval from the Head of the Department coordinating the course, only if this is different from the department organizing the study program.	Head of Department Prof. dr. mat Dorian Popa

Date of approval by the Department Council 28.05.2026	Head of Department *Prof. dr. ing. Mircea Bara*
Date of approval by the Faculty Council 15.09.2026	Dean, Prof.dr.ing. Nicolae Filip