COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Multiphysics Simulations					
2.2 Course convenor			Assoc. Prof. Ph. D. Olivia Florea Prof. Ph. D. eng. Horia ABĂITANCEI					
2.3 Seminar/ laboratory/ project convenor			Assoc. Prof. Ph. D. Olivia Florea Prof. Ph. D. eng. Horia ABĂITANCEI					
2.4 Study year	1	2.5 Semester	1	2.6 Evaluation type	E	2.7 Course status	Content[3)]	CPC
							Attendance type[4)]	AC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/1/1**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/14/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	70
Additional documentation in libraries, specialized electronic platforms, and field research	75
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	2
Tutorial	2
Examinations	3
Other activities.....	2

3.7 Total number of hours of student activity	154
3.8 Total number per semester	210
3.9 Number of credits[5)]	7

4. Prerequisites (if applicable)

4.1 curriculum-related	• Knowledge of Mathematical Analysis, Algad, Special Mathematics, Vehicle Dynamics, Fluid Mechanics, Hydraulics
4.2 competences-related	• Operating with fundamental concepts of engineering sciences

5. Conditions (if applicable)

5.1 for course development	• Computer room with MATLAB and video projector
5.2 for seminar/ laboratory/ project development	• Computer room with MATLAB and video projector

6. Specific competences and learning outcomes

Professional competences	**CP.8 Conducts scientific research** 8.1. Knowledge: ◘ R.Î.8.1.6 – The graduate is able to synthesize information, critically interpret and summarize new and complex information from various sources. 8.2. Skills: ◘ R.Î.8.2.2 – The graduate is able to apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results in view of the relevant estimation of information, as well as related technical systems and their developments. 8.3. Responsibility and autonomy: ◘ R.Î.8.3.1 – The graduate is able to develop research documents or give presentations to report the results of a research project carried out, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results. **CP.12 Designs and executes the virtual model of a product** 12.1. Knowledge: ◘ R.Î.12.1.2 – The graduate will demonstrate fundamental knowledge in the field of computer-aided engineering analysis (CAE): Understanding the basic principles of numerical methods used in CAE: FEM, structural analysis, multi-body dynamics (MBD) simulations 12.2. Skills: ◘ R.Î.12.2.3 – The graduate has the ability to prepare models for simulation: and to perform numerical simulations, to interpret the results. 12.3. Responsibility and autonomy: ◘ R.Î.12.3.2 – The graduate will demonstrate responsibility for the accuracy and validity of the created models, recognize the limitations of numerical models and the importance of their validation through experimental data or other methods.. **CP.13 Develops test procedures** 13.1.Knowledge: ◘ R.Î.13.1.1 – To interpret and analyze the data collected during testing, to formulate conclusions, new perspectives or solutions. 13.2. Skills: ◘ R.Î.13.2.3 – The graduate has the ability to identify problems that may arise and find optimal solutions. 13.3. Responsibility and autonomy: ◘ R.Î.13.3.1 – The graduate has the ability to develop test and validation protocols to allow a variety of analyses of automotive components and systems; CP.15 Uses application-specific interfaces 15.1. Knowledge: ◘ R.Î.15.1.1 – The graduate can evaluate and choose platforms, programming languages and software technologies suitable for projects in the automotive industry;

	15.1. Skills: ◘ R.Î.15.2.1 – The graduate has the ability to understand and apply the principles of programming and software development technologies in the automotive industry;. 15.3. Responsibility and autonomy: ◘ R.Î.15.3.1 – The graduate has the ability to manage software development projects for automotive vehicles, including planning, budgeting and monitoring progress. **CP.16 Designs the user interface** 16.1.Knowledge: ◘ R.Î.16.1.3 – The graduate has in-depth knowledge of specific programming techniques and languages.. 16.2. Skills: ◘ R.Î.16.2.3 – The graduate has the ability to integrate software components with hardware specific to systems or machines (e.g. sensors, actuators, displays, buttons), using appropriate drivers and APIs.. 16.3. Responsibility and autonomy: ◘ R.Î.16.3.2 – The graduate has the ability to effectively manage the time and resources allocated to the development of components, respecting deadlines and budgets.
Transversal competences	**CT.1 Self-management skills and competences** Learning outcomes. The graduate of the master's study program is able to: • R.Î.1.1 assume responsibility, accept accountability for their own decisions, showing willingness to work, respecting their commitments; • R.Î.1.3 show initiative, be proactive, • R.Î.1.12 respect the norms, regulations and guidelines relating to a specific field or sector and apply them in their daily work; • R.Î.1.13 plan activities, manage the calendar and resources to complete tasks in a timely manner. **CT.2 Social and communication skills and competences** Learning outcomes. The graduate of the master's study program is able to: • R.Î.2.1 work in a team; • R.Î.2.2 address an audience, give a speech, make a presentation; • R.Î.2.4 use simple digital tools and technologies to communicate, interact and collaborate with others.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Modeling and simulation play a crucial role in the engineering design process. Modern simulation tools allow the creation of complete system models that take into account all interactions, thus creating multi-physics models. These models accelerate the design and testing process, thus saving human and material resources.
7.2 Specific objectives	• Understanding the principles and potential for automated design using advanced integrated development environments Matlab • Understanding and acquiring the advanced knowledge necessary to develop applications for dynamic simulation of dynamic systems based on Matlab

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. Dynamical systems in Matlab	Interactive course	2	
2. Programming in Matlab	Interactive course	2	

3. Kinematics problems solved in Matlab	Interactive course	2	
4. Dynamics problems solved in Matlab	Interactive course	2	
5. Graphical representations in Matlab	Interactive course	2	
6. Animations in Matlab	Interactive course	2	
7. Fractals in Matlab	Interactive course	2	
8. Multiphysics simulation of thermomechanical system	Interactive course	4	
9. Multiphysics simulation of hydro-mechanical system	Interactive course	4	
10. Multiphysics simulation of electrochemical systems	Interactive course	4	
11. Integrated multiphysics simulation – application vehicle propulsion system	Interactive course	2	

Bibliography

1. Stormy Attaway, Matlab: A Practical Introduction to Programming and problem Solving, Elsevier, 2009
2. Nicoleta Breaz, Marian Crăciun, Păstorel Gaşpar, Maria Miroiu, Iuliana Paraschiv-Munteanu, MODELAREA MATEMATICĂ PRIN MATLAB, 2011
3. B. Rofffel and B. Betlem, Process Dynamics and Control, Modeling for Control and Prediction, John Wiley & Sons, Ltd 2006
4. Luyben, W.L., Process Modeling Simulation, and Control for chemical engineers, McGraw-Hill, 1973.
5. Imre-Lucaci Arpad, Ana-Maria Cormoş, MATLAB, exemple şi aplica ii în ingineria chimică, Ed. Presa Universitară Clujeană, Cluj-Napoca, 2008.
6. Brian D. Hahn and Daniel T. Valentine Essential MATLAB for Engineers and Scientists, Third Edition, Elsevier, 2006.
7. De Silva, C., Modeling of Dynamics Systems with Engiiinering Applications, 2nd Edition, CRC Press, 2022

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
1. Dynamical systems in Matlab	Individual work	2	
2. Programming in Matlab	Individual work	2	
3. Kinematics problems solved in Matlab	Individual work	2	
4. Dynamics problems solved in Matlab	Individual work	2	
5. Graphical representations in Matlab	Individual work	2	
6. Animations in Matlab	Individual work	2	
7. Fractals in Matlab	Individual work	2	
8. Modeling and simulation of a thermo-mechanical dynamic system using Excel and Amesim	Individual work	4	
9. Modeling and simulation of a hydro-mechanical dynamic system using Excel and Amesim	Individual work	4	
10. Modeling and simulation of an electro-chemical dynamic system using Excel and Amesim	Individual work	4	
11. Evaluation of simulation results of an applied integrated multiphysics system specific to vehicle propulsion systems	Individual work	2	

Bibliography

8. Stormy Attaway, Matlab: A Practical Introduction to Programming and problem Solving, Elsevier, 2009
9. Nicoleta Breaz, Marian Crăciun, Păstorel Gaşpar, Maria Miroiu, Iuliana Paraschiv-Munteanu, MODELAREA MATEMATICĂ PRIN MATLAB, 2011

10. B. Rofffel and B. Betlem, Process Dynamics and Control, Modeling for Control and Prediction, John Wiley & Sons, Ltd 2006
11. Luyben, W.L., Process Modeling Simulation, and Control for chemical engineers, McGraw-Hill, 1973.
12. Imre-Lucaci Arpad, Ana-Maria Cormoş, MATLAB, exemple şi aplica ii în ingineria chimică, Ed. Presa Universitară Clujeană, Cluj-Napoca, 2008.
13. Brian D. Hahn and Daniel T. Valentine Essential MATLAB for Engineers and Scientists, Third Edition, Elsevier, 2006.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Theoretical and practical approaches demonstrate the latest programming ideas for automotive design. The curriculum is consistent with similar fields addressed to universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	**Continuous activity and course participation** ◘ active presence and reasoned interventions during the presentation of theoretical notions and demonstrative applications; ◘ integration of theoretical knowledge into discussions by correlating modeling principles with practical applications in Matlab; ◘ demonstration of critical and reflective thinking on multiphysics models, including by analyzing their advantages and limitations in engineering design.	◘ Ongoing evaluation	10%

10.5 Seminar/ laboratory/ project	**Continuous activity and participation in the laboratory** ◘ active participation in Matlab exercises and simulations: running scripts correctly, asking pertinent questions, getting involved in solving problems; ◘ preparing tasks before the laboratory (reviewing Matlab code, going through course materials, checking previously taught algorithms); ◘ team collaboration in developing simulation projects (thermo-mechanical, hydro-mechanical, electro-chemical) and arguing their own solutions. **Carrying out applied tasks** ◘ correct solving of the tasks posted on the e-learning platform: ◘ Matlab programming exercises for dynamic systems; ◘ implemented and simulated kinematics and dynamics problems; ◘ Matlab graphical representations and animations; ◘ modeling and simulation of a complete multi-physics system (e.g. car). ◘ correct use of Matlab software and associated toolboxes; ◘ the ability to validate and interpret simulation results through comparisons, analyses and coherent explanations.	◘ Ongoing evaluation	30%
	Practical test (complex test) ◘ ability to analyze a new multiphysics model and propose the corresponding Matlab solution; ◘ creative application of knowledge in solving a problematic engineering situation; ◘ clarity in organizing the code and explanations. **Oral test** ◘ accuracy of the model; ◘ explanation of modeling decisions and choice of parameters; ◘ fluency, rigor, and autonomy in presenting and interpreting results.	◘ Summative assessment (practical and oral)	60%
10.6 Minimal performance standard			
The student demonstrates understanding of the basic notions regarding modeling and simulation of dynamic systems			

and the ability to coherently apply them in Matlab to solve elementary multiphysics simulation exercises.
Minimum Objectives:
◘ R.Î.8.1.6: The student can identify information from at least one source and render it simply to support a basic simulation.
◘ R.Î.8.2.2: The student applies an elementary documentation method (e.g. consulting a Matlab manual) and briefly presents the results.
◘ R.Î.8.3.1: The student writes a simple report describing the steps and results of a Matlab simulation.
◘ R.Î.12.1.2: The student recognizes the fundamental notions of multi-body simulation and applies them in a basic Matlab example.
◘ R.Î.12.2.3: The student prepares a simple model for simulation and provides a general interpretation of the results obtained.
◘ R.Î.12.3.2: The student recognizes the limitations of the created model and mentions at least one possible source of error.
◘ R.Î.13.1.1: The student correctly interprets the basic results obtained from a Matlab simulation.
◘ R.Î.13.2.3: The student identifies a simple problem in the simulation (e.g. wrong parameters) and proposes an elementary correction.
◘ R.Î.13.3.1: The student develops a minimal validation protocol (e.g. compares the simulation results with a simple theoretical value).
◘ R.Î.15.1.1: The student selects Matlab/Simulink as a suitable platform for solving an elementary simulation.
◘ R.Î.15.2.1: The student writes and executes a simple Matlab script (basic operations, simple graphics).
◘ R.Î.15.3.1: The student completes a small simulation project, respecting the established deadline.
◘ R.Î.16.1.3: The student recognizes basic programming techniques for interfaces and applies them in a simple example.
◘ R.Î.16.2.3: The student integrates a Matlab/Simulink model with a simple component (e.g. an input/output block).
◘ R.Î.16.3.2: The student demonstrates that he can manage the time required to perform a simple simulation.

Performance level evaluation grid

Performance level	General description	Features
Excellent (10–9)	Fully masters the concepts of multiphysics modeling and simulation; the solutions are innovative, correct and well documented.	Impeccable use of technical terminology; logical structure in code and documentation; autonomy in developing simulations; critical thinking on results.
Very good (8)	Demonstrates a solid understanding of concepts and correctly applies Matlab methods to multiphysics problems.	Minor code or interpretation errors may occur, but the analysis is coherent and applicable; it correctly explains the choice of parameters and simulation steps.
Good (7)	Understands the basic concepts, but the application in Matlab is partial or incomplete.	Sometimes inaccurate terminology; functional but flawed Matlab scripts; incomplete explanations; superficially interpreted results.
Sufficient (6)	Mechanically applies the basics without critical reflection on the simulation.	Partially correct solutions; frequent code or logic errors; lack of consistency in interpreting results.
Insufficient (<5)	It does not demonstrate understanding of fundamental modeling and simulation concepts.	Theoretical and practical confusion; wrong or non-existent Matlab applications; lack of argumentation and interpretation of results.

This course outline was certified in the Department Board meeting on 08.09.2025 and approved in the Faculty Board meeting on 09.09.2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	**Prof. dr. ing. Mihai DUGULEAN**Ă**,** **Head of Department**
Assoc. Prof. Ph. D. Olivia Florea**,** Prof. Ph. D. eng. Horia ABĂITANCEI**,** **Course holder**	Assoc. Prof. Ph. D. Olivia Florea**,** Prof. Ph. D. eng. Horia ABĂITANCEI**,** **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			CAD and Graphics programming					
2.2 Course convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.3 Seminar/ laboratory/ project convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	1	2.5 Semester	1	2.6 Evaluation type	E	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	CPC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/1/1**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/14/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	25
Additional documentation in libraries, specialized electronic platforms, and field research	35
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	45
Tutorial	14
Examinations	2
Other activities.....	3

3.7 Total number of hours of student activity	124
3.8 Total number per semester	180
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• Knowledge of Mathematical Algebra, Elementary CAD notions Cunoașterea algebricii matematice, noțiuni elementare CAD
4.2 competences-related	• Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 for course development	• projector • lecture notes • recommended bibliography
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • virtual and augmented reality equipments • lecture notes

	• recommended bibliography

6. Specific competences and learning outcomes

Professional competences	Cp1. Uses technical drawing software L.O.1.1 The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. L.O.1.2 The graduate evaluates the usefulness, advantages and limitations of technical drawing software applications. L.O.1.3 The graduate interprets the technical drawings of a product made by the engineer to suggest improvements, to make models of the product or to exploit it. L.O.1.4 The graduate demonstrates autonomy in learning on issues specific to the field. Cp2. Design and execute the virtual model of a product L.O.2.1 The graduate will demonstrate in-depth knowledge of the fundamental principles of computational geometry and the mathematical representation of three-dimensional shapes, the differences and applications of wireframe, surface and solid models, as well as the concepts of parametric and direct modeling. L.O.2.2 The graduate has the ability to fluently use CAE/CAD software to create 3D models: This includes modeling complex parts, assemblies, generating technical drawings and applying geometric constraints and relationships. L.O.2.3 The graduate has the ability to optimize product design based on simulation results to improve the performance, reliability or efficiency of an automotive component or system. L.O.2.4 The graduate has the ability to integrate various software tools and manage data transfer between them. L.O.2.5 The graduate will demonstrate autonomy in choosing appropriate modeling tools and methods. L.O.2.6 The graduate will demonstrate a proactive attitude in solving problems, by identifying and addressing technical challenges related to modeling and simulation, seeking innovative and effective solutions. Cp3. Prepare prototypes for production L.O.3.1 The graduate will demonstrate in-depth knowledge of the fundamental principles of engineering design: understanding the product development cycle, innovation processes, design thinking and systems design methodologies. L.O.3.2 The graduate has the ability to create detailed digital models, ready for additive manufacturing or other prototyping methods. L.O.3.3 The graduate has the ability to work independently in the design and development phases of prototypes, making informed decisions. Cp4. Uses application-specific interfaces L.O.4.1 The graduate can evaluate and choose platforms, programming languages, and software technologies suitable for automotive industry projects. L.O.4.2 The graduate has the ability to understand and apply the principles of programming and software development technologies in the automotive industry. L.O.4.3 The graduate has the ability to manage automotive software development projects, including planning, budgeting, and monitoring progress.

Transversal competences	Ct1. Self-driving skills and competencies L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Social and communication skills and competencies L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.4 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Enhance the theoretical knowledge of CAD modeling and identifying their specific solutions for automotive design; • Training and skills development of advanced 3D graphics programming; • Develop specific programming skills in CAD / CAE languages ; • Enhance the techniques of computer aided design of parts / assemblies on which the virtual prototype of the product is achieved throughout the life cycle; • Training and skills development of students on the use of specialized equipment currently used in CAD and 3D graphics programming.
7.2 Specific objectives	• Develop the capacity to p implement projects in automotive design; • Develop skills on three-dimensional modelling of parts and assemblies; • Develop skills in using adequate CAD programs to accurate and fast solving of graphics representations. • Develop skills in 3D graphics programming. • Develop skills in specific programming CAD / CAE languages.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Introduction. The aim of the course. Framing 3D modeling and programming in assisted engineering. Current automotive design requirements. Product development using CAD / CAE and 3D graphics.	Interactive lecture	2 hours	
3D graphics-aided design: defining basic elements and algorithms.	Interactive lecture	2 hours	
Geometric modeling – Curve entities; analytic and synthetic. Surface entities; Ruled, tabulated, Coons, Bezier, and B-spline surfaces. Advance Surface	Interactive lecture	2 hours	

modeling.			
Methods of creating solid models: Boundary Representation (B-rep), Euler operator, Euler/Poincare formula. Constructive Solid Geometry (CSG), primitive solids, Boolean operations. Parametric Modeling, feature-based modeling.	Interactive lecture	2 hours	
Basics of assembly, Top-Down and Bottom-Up design, degrees of freedom, mating components	Interactive lecture	2 hours	
Architecture CAD software. CAD development kernels. Typical functionality of professional CAD software. Commercial CAD software - features and performance.	Interactive lecture	2 hours	
Intelligent CAD systems (KBD). Knowledge representation. Description of the Intelligent CAD systems.	Interactive lecture	2 hours	
CAD applications programming using Visual Basic. Syntax elements. Common programming techniques.	Interactive lecture	4 hours	
3D graphics programming using OpenGL. Algorithms for 3D graphics programming. Modeling of primitives using OpenGL. Generic surface modeling. 3D transformations. 3D viewing. Advanced lighting techniques. Visualization techniques: perspective view, rendering, lighting, image control.	Interactive lecture	4 hours	
Computer animation. Methods for obtaining frames. Method "keyframe" (keyframes). Simulation method. Techniques for obtaining frames. Creating animations using OpenGL and VRML languages.	Interactive lecture	2 hours	
Demonstration applications of CAD systems and advanced programming algorithms and visualization of 3D graphics in automotive design.	Interactive lecture	4 hours	

Bibliography

1. Gîrbacia Florin, Computer Aided Design: course notes, Editura Universității Transilvania din Brașov, 2020. ISBN 978-606-19-1332-9.
2. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
3. Talabă, D., Bazele CAD. Proiectare asistată de calculator. Editura Universită ii Transilvania, Braşov, 2000.
4. Gîrbacia, F., Talabă, D., Tehnologiile realității virtuale:lucrări practice, Ed. Universită ii Transilvania Braşov, 2012.
5. Preda,I., Inginerie asistată de pentru autovehicule, Editura Universită ii Transilvania din Braşov, 1998.
6. C. Anghel, G. Şimon, Grafică Tehnică Asistată de Calculator, Editura Risoprint, Cluj-Napoca, 2008.
7. D. Dragomir,CAD Proiectare asistată de calculator pentru inginerie mecanică, Editura Teora, 1996.
8. Zeid, I., Mastering CAD CAM, McGraw Hill, 1991.
9. Lee, Kunwoo, Principles of CAD/CAM/CAE Systems, Addison/Wesley, 1999.
10. Hearn, D., Baker P., "Computer Graphics with OpenGL", Prenticel Hall, 2003.
11. Foley J. D., Van Dam A., Feiner S. K., Hughes J. F., Computer Graphics - Principles and Practice, Second Edition in C, Pearson Education, 2003.

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Getting on the use and configuration of CATIA program, specific terms. Sketching techniques. Sketcher CATIA Module. Constraints modeling tools. Profile modeling tools. Operation modeling tools.	Interactive lecture, exercises and examples, individual work	2 hours	
Solid modeling module. CATIA Part Design module. Sketch-Based Modelling Tools Features. Surface-Based Features. Dress-up Features. Transformation Features. Boolean Operations.	Interactive lecture, exercises and examples, individual work	4 hours	
Creating models for assemblies, CATIA Assembly Design module. Product Structure Tool assembly tools. Constraints Tool assembly tools. Features Assembly assembly tools. Applications in vehicle design.	Interactive lecture, exercises and examples, individual work	2 hours	
CATIA CAD applications programming using Visual Basic. Creating script files. Saving and running a script file. Creating GUI.	Interactive lecture, exercises and examples, individual work	6 hours	
OpenGL programming applications for automotive design.	Interactive lecture, exercises and examples, individual work	2 hours	
VRML programming applications for automotive design.	Interactive lecture, exercises and examples, individual work	6 hours	
Developing applications in automotive design.	Interactive lecture, exercises and examples, individual work	6 hours	

Bibliography

1. Gîrbacia Florin, Computer Aided Design: course notes, Editura Universității Transilvania din Brașov, 2020. ISBN 978-606-19-1332-9.
2. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
3. Gîrbacia, F., Talabă, D., Tehnologiile realității virtuale:lucrări practice, Ed. Universită ii Transilvania Braşov, 2012.
4. Gîrbacia Florin, Duguleană Mihai (2019): Virtual and augmented reality in automotive design and maintenance: course notes, Editura Universitatii Transilvania din Brasov, ISBN 978-606-19-1124-0.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Theoretical knowledge underpins the latest approaches in programming and 3D modeling for the field of automotive design. The analytical curriculum is consistent with similar fields addressed at universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	The ability to apply the knowledge of design and assisted graphics	Written exam	50%
10.5 Seminar/ laboratory/ project	The ability to use modern CAD and graphic programming techniques, skills and tools	Solving practical applications	50%
10.6 Minimal performance standard			
◘ Knowledge of the fundamentals of CAD graphics programming ◘ Modeling an interactive virtual 3D environment for engineering applications ◘ Carrying out laboratory work ◘ The grades obtained for the project and exam activity must be at least 5			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, ... **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** ..... **Head of Department**
Prof. Ph. D. eng. Florin GÎRBACIA, ... **Course holder**	Prof. Ph. D. eng. Florin GÎRBACIA, ... **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design (in English)

2. Data about the course

2.1 Name of course			Dynamics of multibody systems					
2.2 Course convenor			Prof.dr.ing. Antonya Csaba					
2.3 Seminar/ laboratory/ project convenor			Prof.dr.ing. Antonya Csaba					
2.4 Study year	1	2.5 Semester	1	2.6 Evaluation type	E	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	CFC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/1/1**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/14/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	70
Additional documentation in libraries, specialized electronic platforms, and field research	50
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	24
Tutorial	7
Examinations	3
Other activities.....	0

3.7 Total number of hours of student activity	154
3.8 Total number per semester	210
3.9 Number of credits[5)]	7

4. Prerequisites (if applicable)

4.1 curriculum-related	•
4.2 competences-related	• Basic knowledge of mechanics

5. Conditions (if applicable)

5.1 for course development	• Classroom, video projector
5.2 for seminar/ laboratory/ project development	• Laboratory with computers

6. Specific competences and learning outcomes

Professional competences	C.2 Competences to carry out scientific research. L.O.2.1 To carry out scientific research, to conceive or create new knowledge by formulating questions in the field by researching, improving or developing concepts, theories, models, techniques, tools, software or operational methods and by using methods and techniques scientific; L.O.2.2 To gather information about current trends and styles regarding vehicles and the need for new products or services; L.O.2.3 To prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep up with recent discoveries; L.O.2.4 To prepare research documents or give presentations to report the results of an ongoing research project, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results; L.O.2.5 To synthesize information, critically interpret and summarize new and complex information from various sources; C.4 Skills to use CAD-CAM-CAE systems L.O.4.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.4.2 using computer-aided engineering programs to perform stress analyzes for engineering projects. C.5 Ability to design and develop software L.O.5.1 to develop software for motor vehicles and related systems; L.O.5.2 understand and apply the principles of programming and software development technologies in the automotive industry; L.O.5.3 to evaluate and choose suitable platforms, programming languages and software technologies for projects in the automotive industry; L.O.5.4 to develop software applications to improve the functionality, performance and safety of motor vehicles; L.O.5.5 to test and debug software to ensure the proper and safe operation of vehicle systems; L.O.5.6 to integrate software systems in the global architecture of motor vehicles, taking into account security and compatibility aspects; L.O.5.7 manage automotive software development projects, including planning, budgeting and monitoring progress. C.6 Skills to use CAD-CAM-CAE systems L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.6.2 the use of computer-aided manufacturing (CAM) programs to control machines and machine tools in the creation, modification, analysis or optimization processes as part of the manufacturing processes of motor vehicle parts; L.O.6.3 using computer-aided engineering programs to perform stress analyzes for engineering projects.
Transversal competences	Ct.1 Competences for integration into specific activities at the workplace and technical competencies, in conditions of autonomy and professional independence L.O.1.1 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.2 to show initiative, to be proactive, L.O.1.3 to provide advice to colleagues, offering suggestions on the best way forward; L.O.1.4 to be able to work in a team but also independently develop their own ways of doing things, showing the desire to learn, L.O.1.5 to analyze new problems, based on creative, innovative, analytical, and holistic thinking;

	Ct.2 Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O.2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• The objective of this course is to present the theoretical knowledge of the foundations of Multibody Dynamics with applications in Automotive Engineering: analytical foundations for the systematic generation of motion equations, numerical methods for their solution and interpretation of simulation results.
7.2 Specific objectives	• Become familiar with methodology, algorithms and software for kinematic and dynamic simulation of complex mechanical systems, automotive systems (automotive and mechanical subsystems composed of rigid elements) • Given a mechanical system, understand how to generate in a systematic and general fashion the equations that govern the time evolution • Have a basic understanding of the techniques (numerical methods) used to solve the equation of motion for multibody systems • Be able to use software to simulate and interpret the dynamics associated with complex mechanical systems • Laboratory exercises and the project aimed at introducing multibody systems simulation tools: software tools MSC.Adams and/or Matlab-Siscape-Multibody

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Introduction. Background, classification of methods, history, modelling fundamentals, computational methods.	The use of classical and multimedia teaching techniques (computer, video projector)	2	
Kinematic analysis of multibody systems (MBS) Analysis of elements in MBS Bodies: classification, representation Connections between bodies: joints, degrees of freedom The degree of freedom of the MBS, loops, topology map Translation and rotation; coordinate transformation Velocity and acceleration Generalized coordinates Formulation of the kinematic model Absolute and relative constraints Constraint equations imposed by joints Driver constraints, motion Kinematic analysis: equations for kinematics Solving nonlinear equations for the kinematic model,	Teaching based on significant examples to provide motivation and explanation of the basic concepts and specific methods, highlighting the relevant ideas	10	

the Newton-Raphson method The Jacobi matrix Equations for computing velocity and acceleration The multi-body algorithm for kinematics			
Dynamic analysis of multibody systems Dynamical model for a system of rigid bodies Euler-Lagrange formulation Mass and mass distribution Principle of Virtual Work, virtual Displacements D'Alembert's Principle Variational equation of motion for a rigid body Newton-Euler Equations Forces and torques acting on a body External forces, load cases Lagrange multiplier theorem Lagrange form of the constrained equations of motion Forces acting on MBS Force-generating elements: springs, dampers Input data defining the dynamic model of the MBS Formulating dynamic model, Newton-Euler equations, Lagrange multipliers Automatic formulation of dynamic equations Numeric integration of the equation of motion Initial Conditions Euler's method Runge-Kutta methods Multi-step methods Numerical solution methods for differential-algebraic equations Newmark's integration formulas Determination of the joint forces Invers dynamics Equilibrium analysis		8	
Optimization of complex multibody systems Adapting the design parameters kinematic / dynamic function moving purposes Adapting motion parameters to a function design goal		4	
Commercial packages like MSC ADAMS/Matlab-Simscape-Multiboody Commercial software can automatically generate and solve for the response of complex MBS Shortcomings of these methods, issues related to kinematics, forward and inverse dynamics, and singularities.		4	
Bibliography Haug, E. J., Computer Aided Kinematics and Dynamics of Mechanical Systems: Basic Methods, Wiley, 1989. Shabana, A. A., Dynamics of Multibody Systems, Cambridge University Press, 2005. Wittenburg, J. Dynamics of Multibody Systems, Springer-Verlag, 2008.			

Jalon, J.G., Bayo, E., Kinematic and Dynamic Simulation of Multibody Systems – The real time challenge, Springer-Verlag, 1994.
Schiehlen W. O., Multi-body Systems Handbook, Springer Verlag, Berlin-New York, 1990.
Nikravesh P. E., Planar Multibody Dynamics: Formulation, Programming and Applications, Taylor & Francis Group, 2008.
Hahn, R., Rigid Body Dynamics of Mechanisms, Springer, 2002
Talabă D., Mecanisme Articulate. Proiectare Asistată de Calculator, Transilvania University Press, 2001
Negrut D., Kinematics and Dynamics of Machine Systems, University of Wisconsin, Madison
Geradin, M., Cardona A., Flexible Multibody Dynamics, Wiley, 2001.
Antonya, Cs., Simularea grafică a sistemelor de corpuri, Editura Transilvania University Press, 2004.
Antonya, Cs., Boboc, R.G., Mechanisms: theory and examples. Transilvania University Press, 2023.

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
1. Kinematic analysis of MBS	Experimental activity on multibody systems developed with Matlab-Simscape-Multibody or MSC ADAMS. Explanations, examples, interactivity, case studies	2	
2. Dynamic analysis of MBS with rigid elements		2	
3. Dynamic analysis of MBS with rigid elements, equilibrium		2	
4. Inverse dynamics		2	
5. Presentation of results and graphical simulation of MBS		2	
6. Optimization of MBS		2	
7. Evaluation.		2	
Project: Theoretical subject: write a report of 4-5 pages about an imposed theoretical topic. MBS simulation in MSC ADAMS or Matlab-Simscape-Multibody (kinematic and/or dynamic). Write a 5-6 pages report about the model with: ◘ Model description ◘ Simulation premises ◘ Initial conditions ◘ Components, degrees of freedom, joints, forces, masses ◘ Building the model ◘ Results, interpretation of results The model will have more than 4 bodies. It can be a kinematic or dynamic simulation, but motivate your decision.		7 x 2	

Bibliography

ADAMS User Guide MSC Software
Haug, E. J., Computer Aided Kinematics and Dynamics of Mechanical Systems: Basic Methods, Wiley, 1989.
Shabana, A. A., Dynamics of Multibody Systems, Cambridge University Press, 2005.
Wittenburg, J. Dynamics of Multibody Systems, Springer-Verlag, 2008.
Schiehlen W. O., Multi-body Systems Handbook, Springer Verlag, Berlin-New York, 1990.
Nikravesh P. E., Planar Multibody Dynamics: Formulation, Programming and Applications, Taylor & Francis Group, 2008.
Hahn, R., Rigid Body Dynamics of Mechanisms, Springer, 2002
Talabă D., Mecanisme Articulate. Proiectare Asistată de Calculator, Transilvania University Press, 2001

Negrut D., Kinematics and Dynamics of Machine Systems, University of Wisconsin, Madison
Antonya, Cs., Simularea grafică a sistemelor de corpuri, Editura Transilvania University Press, 2004.
Antonya, Cs., Boboc, R.G., Mechanisms: theory and examples. Transilvania University Press, 2023.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Studying theoretical subjects and applications ensures the formation of skills related to the design and analysis of multibody systems of motor vehicles and understanding the interaction of mechanical systems. These skills are needed in the design and analysis of modern vehicles. Completing the course involves knowing and using software tools for designing modern mechanical systems in an integrated and optimal approach.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Using basic knowledge to explain and interpret algorithms for multibody systems	Oral examination	33%
10.5 Seminar/ laboratory/ project	According to the project subject (theoretical and simulation)	Presentation	67%
10.6 Minimal performance standard			
• Use basic knowledge to explain and interpret algorithms for multibody systems, • Elaboration of a project with an imposed theme, • The grades obtained for the homework and exam must be at least 5.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	Prof.dr.ing. Mihai DUGULEANĂ, **Head of Department**
Prof.dr.ing. Csaba ANTONYA, **Course holder**	Prof.dr.ing. Csaba ANTONYA, **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transports
1.4 Field of study[1)]	Master of Automobiles Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Tribology					
2.2 Course convenor			Prof. Ph.D. Eng. Radu Velicu/ Prof. Ph.D. Eng. Daniel Munteanu					
2.3 Laboratory			Prof. Ph.D. Eng. Radu Velicu/ Conf. Ph.D. Eng. Camelia Gabor					
2.4 Study year	I	2.5 Semester	1	2.6 Evaluation type	E	2.7 Course status	Content[3)]	DAP
							Attendance type[4)]	DI

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/2/0**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/28/0

Time allocation	hours
Study of textbooks, course support, bibliography and notes	25
Additional documentation in libraries, specialized electronic platforms, and field research	35
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	45
Tutorial	14
Examinations	5
Other activities	-

3.7 Total number of hours of student activity	124
3.8 Total number per semester	180
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• Solid mechanics; Strength of Materials, Machines Parts
4.2 competences-related	• Knowledge and abilities to work in one or more standard or high-level programming languages (e.g., Excel, Matlab)

5. Conditions (if applicable)

5.1 for course development	• classroom, projector
5.2 for seminar/ laboratory/ project development	• computer room, dedicated software, testing devices

6. Specific competences and learning outcomes

Professional competences	PC.1 Adjusts product designs Learning outcomes 1.1 Knowledge L.O.1.1.1 The graduate has the ability to interpret the technical requirements of customers, analyzing, understanding and applying the information provided regarding the technical conditions; L.O.1.1.2 The graduate has the ability to define technical design requirements, by specifying the technical properties of goods, materials, methods, processes, services, systems, software and functionalities, by identifying and addressing the specific needs that must be satisfied according to the customer's requirements; 1.2 Skills L.O.1.2.1 The graduate has the ability to use advanced concepts, techniques and principles regarding the design of modern systems and equipment for motor vehicles; R.Î.1.2.5 develop test protocols for motor vehicle components and equipment; 1.3 Responsibility and autonomy L.O.1.3.1 planning and managing various types of resources (human, financial, deadlines) of the activities and results of a given project; monitoring the degree of achievement of specific project objectives within a certain period of time and with a predetermined budget;
	PC.2 Analyzes production processes in order to improve Learning outcomes 2.1. Knowledge L.O.2.1.1. The graduate identifies and explains the basic concepts, theories and methods of the field of automotive engineering and the specialization. L.O.2.1.2. The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. 2.3. Responsibility and autonomy L.O.2.3.1. The graduate demonstrates autonomy in learning on issues specific to the field.
	PC.3 Anticipates changes in automotive technology Learning outcomes 3.1. Knowledge L.O.3.1.1. The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. 3.2. Skills L.O.3.2.1. The graduate demonstrates knowledge and use of advanced analysis methods in the construction and operation of automotive vehicles. 3.3. Responsibility and autonomy L.O.3.3.1. The graduate demonstrates autonomy in learning on issues specific to the field.

	PC.8 Conducts scientific research Learning outcomes 8.1 Knowledge L.O.8.1.1 The graduate demonstrates in-depth knowledge and complex understanding of the research field, including responsible research, ethical principles and scientific integrity in research, respect for privacy and GDPR requirements, related to research activities in a given discipline. L.O.8.1.2 The graduate conducts scientific research, conceives and creates new knowledge by formulating questions in the field through research, improvement or development of concepts, theories, models, techniques, instruments, software or operational methods and by using scientific methods and techniques; L.O.8.1.5 The graduate is able to prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers to keep up with recent discoveries; L.O.8.1.6 The graduate is able to synthesize information, interpret and critically summarize new and complex information from various sources. 8.2 Skills L.O.8.2.1 The graduate is able to operate scientific and laboratory research equipment; L.O.8.2.2 The graduate is able to apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results in view of the relevant estimation of information, as well as related technical systems and their developments 8.3 Responsibility and autonomy L.O.8.3.1 The graduate is able to develop research documents or give presentations to report the results of a research project carried out, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results. L.O.8.3.3 The graduate is able to manage data in the field of research.
	CP.13 Develops test procedures Learning outcomes 13.1 Knowledge L.O.13.1.1 Interpret and analyze data collected during testing, to formulate conclusions, new perspectives or solutions. L.O.13.1.2 Record data that has been specifically identified during previous tests, to verify that the test results produce specific results; L.O.13.1.3 Collect data and statistics for testing and evaluation to generate statements and pattern predictions, in order to discover useful information in the decision-making process; 13.2 Skills L.O.13.2.1 The graduate has the ability to operate precision measuring equipment; L.O.13.2.3 The graduate has the ability to identify problems that may arise and find optimal solutions; L.O.13.2.8 The graduate has the ability to select, acquire and use automotive testing equipment; L.O.13.2.9 The graduate has the ability to evaluate the possibility that a system or its components can be obtained by applying certain engineering principles. 13.3 Responsibility and autonomy L.O.13.3.1 The graduate has the ability to develop test and validation protocols to allow a variety of analyses of automotive components and systems;

Transversal competences	TC.1 Self-driving skills and competences Learning outcomes. The graduate of the master's study program is able to: L.O.1.1 assume responsibility, accept accountability for their own decisions, showing willingness to work, respecting their commitments; L.O.1.2 to demonstrate determination, making sustained efforts for success by pursuing clear objectives, to make decisions by choosing from several alternative possibilities; R.Î.1.9 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, instruments or digital equipment; L.O.1.13 to plan activities, manage the calendar and resources to complete tasks in a timely manner.
	TC.2 Social and communication skills and competences Learning outcomes. The graduate of the master's study program is able to: L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.10 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• The acquisition by students of fundamental concepts in tribology as a science that addresses phenomena of friction, lubrication, and wear in relation to practical applications. • The purpose of the lab is to introduce students to high-performance equipment for analyzing friction, lubrication, lubricant properties, and wear.
7.2 Specific objectives	• Understanding the phenomena and mechanisms of friction • Understanding the role of lubrication and the necessary properties of lubricants • Understanding the phenomena of boundary, mixed, and hydrodynamic lubrication • Understanding the mechanisms of wear development, conditions of occurrence, and methods of reduction • Developing practical skills for operating specific equipment to measure defining parameters for friction, lubrication, and wear phenomena

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1.Introduction (meaning of friction, lubrication and wear).	Lectures, discussion	2 hrs	
2.Dry friction (surfaces topography of solids, model of contact, friction and wear, stick-slip)	Lectures, discussion	2hrs	
3.Wear (Abrasive, erosive and cavitation wear, fatigue wear (sliding, rolling)	Lectures, discussion	2hrs	
4.Wear (Abrasive, erosive and cavitation wear, fatigue wear (sliding, rolling)	Lectures, discussion	2hrs	
5.Lubricants (dynamic and kinematic viscosity, viscosity-temperature relationship, viscosity-pressure relationship, measurements, classification, types of lubricants and their description - mineral and	Lectures, Discussion	6hrs	

synthetic oils, greases; additives)			
6.Hydrodynamic lubrication (Conditions for HDL, simplifying assumptions, Reynolds equation, simplifications, bearing parameters from Reynolds eq., application for journal bearings - pressure distribution, load capacity, friction, power loss; Stribeck curve, squeeze films and Reynolds eq.)	Lectures, Discussion	6hrs	
7.Improving the tribological properties of metallic parts by diffusion surface treatments - surface modification by altering surface chemistry (high temperature diffusion treatments: carburizing and carbonitriding; low temperature diffusion treatments: nitriding and nitrocarburizing – principles, technological parameters, mechanical and tribological surface properties before and after treatment).	PPT presentation, discussion	4hrs	
8.Integrating tribological coating systems into the surfaces design process – surfaces modification by adding new material onto the surface (tribological coatings and their properties, deposition technologies and technological parameters – advantages and disadvantages, applications, substrates preparation, duplex processes).	PPT presentation, discussion	4hrs	
9.Micro-nanomechanics/micro-nanotribology (tribological thin films and multilayers, surfaces topography by AFM and STM, micro-scale friction, atomic scale friction, directionality effect on microfriction, micro/nanoindentation – hardness and elastic modulus, micro/nano wear and scratching, boundry lubrication	PPT presentation, discussion,	2hrs	
10.Micro-nanomechanics/micro-nanotribology (tribological thin films and multilayers, surfaces topography by AFM and STM, micro-scale friction, atomic scale friction, directionality effect on microfriction, micro/nanoindentation – hardness and elastic modulus, micro/nano wear and scratching, boundry lubrication	PPT presentation, discussion,	2hrs	

Bibliography

1. Gohar, R., Rahnejat, H. Fundamentals of tribology, Imperial College Press, 2012
2. Stachowiak, G.W., Batchelor, A.W. Engineering tribology, Elsevier, 3rd ed. 2005
3. John Williams - Engineering Tribology, 2005
4. Shizhu Wen, Ping Huan - Principles of Tribology, 2012
5. Ohring, M., Materials Science of thin films – Deposition & Structure, 2nd edition, Academic Press, San Diego, 2012.
6. Campbell, D.S., Handbook of Thin Film Technology, eds. L.I. Maissel and R. Glang, McGraw-Hill, New York, 1970.
7. CSM Instruments, Manual of Instrumentation methods, Pesseux, Switzerland, 2011.
8. Ohring, M., Engineering Materials Science, Academic Press, San Diego, 1995.
9. Hoffman, R.W., Physics of thin films, academic Press, New York, 1996.
10. Nix, W.D., Metallurgical Trans., 20A, 2217, (1989).
11. Daniel Munteanu, Camelia Gabor, ș.a., Straturi subtiri de tip Ti-Si-C si Ti-O-C obtinute prin pulverizare reactiva in sistem magnetron, Editura Universitatii Transilvania din Brasov, 2007.

8.2 Laboratory	Teaching-learning methods	Number of hours	Remarks
1. Tribometer (description, specifications, destinations, use)	On site presentation	2	Weekly report
2. Ball on disk continuous test for dry, boundary or mixed lubrication (Stribeck curve)	Experimental reading and analyse	2	Weekly report
3. Pin on plate oscillation test for dry, boundary or mixed lubrication		2	Weekly report

4. Block on ring test for boundary or mixed lubrication		2	Weekly report
5. Ball on plate oscillation test for static and dynamic friction, stick – slip test		2	Weekly report
6. General presentation of laboratory equipment for surface testing: ball-on-disk tribometer (CSM Instruments), Compact platform (for micro- and nano-level indentation and scratching).		2	Weekly report
7. Wear tests using the pin-on-disk tribometer. Determination of wear and friction coefficients under various conditions.		2	Weekly report
8. Testing adhesion of tribological thin-films using the scratch-testing method.		2	Weekly report
9. Surfaces topography evaluation at micro and nano levels (mechanic profilometer method and Atomic Force Microscopy method).	General presentation and principle of analysis	2	Weekly report
10. Establishing coatings/thin film thickness and adhesion; Ball-cratering technique and scratch test.		2	Weekly report
11. The indentation method; establishing the elastic modulus and indentation hardness of coatings and thin films.		2	Weekly report
12. Tribology; establishing the dynamic friction coefficient for coatings and thin films using the ball-on-disk tribometer.		2	Weekly report
13. Tribology; establishing the wear rate of coatings and thin films using Ball-on-disk tribometer and using the profilometer method.		2	Weekly report
14. Deposition of tribological purpose thin films on stainless steel.		2	Weekly report

Bibliography

1. UMT3, Reference manual, 2011
2. UMT3, Application manual, 2012
3. Bhushan, B., Handbook of Micro/nanotribology, Second edition, CRC Press, LLC, 1999.
4. CSM Instruments, Manual of Instrumentation methods, Pesseux, Switzerland, 2011.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

In corroboration with Industrial Companies interests.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Theory understanding	Grid test, objective evaluation	50%
	Correct use of terminology		
10.5 Seminar/ laboratory/ project	Ability to recognize the phenomena related to friction, lubrication and wear	Practical work/oral presentation, subjective evaluation	50%
	Efficient communication Correctness of graphical representations and numeric calculus Correct Conclusions		
10.6 Minimal performance standard			

The passing grade for both the course and the laboratory is obtained by demonstrating the ability to identify and define the main processes in tribology (friction, lubrication, wear) and knowledge of the main practical methods used in the tribology laboratory.

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof. Ph.D. Eng. Ioan Călin ROȘCA, **Dean**	**Prof. Ph.D. Eng. Mihai DUGULEANĂ** **Head of Department**

Course holder, ***Prof. dr. ing. Radu VELICU*** **Course holder,** **Prof. dr. ing. Daniel MUNTEANU**	**Holder of laboratory,** ***Prof. dr. ing. Radu VELICU*** **Holder of laboratory,** **Conf. dr. ing. Camelia GABOR**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Practice for research and development I					
2.2 Course convenor								
2.3 Seminar/ laboratory/ project convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	1	2.5 Semester	1	2.6 Evaluation type	C	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	**NCPC**

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**12**	out of which: 3.2 lecture	**0**	3.3 seminar/ laboratory/ project	**0/0/12**
3.4 Total number of hours in the curriculum	168	out of which: 3.5 lecture	0	3.6 seminar/ laboratory/ project	168

Time allocation	hours
Study of textbooks, course support, bibliography and notes	
Additional documentation in libraries, specialized electronic platforms, and field research	
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	
Tutorial	
Examinations	
Other activities.....	

3.7 Total number of hours of student activity	168
3.8 Total number per semester	168
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Elementary concepts of automotive engineering, computer-aided design
4.2 competences-related	• Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 for course development	• projector • lecture notes • Windows operating system, Catia V5, Matlab
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • Windows operating system, Catia V5, Matlab

6. Specific competences and learning outcomes

Professional competences	C1. Automobile Construction L.O.1.1 The graduate identifies and explains the basic concepts, theories and methods of the field of automotive engineering and the specialization. L.O.1.2 The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. L.O.1.3 The graduate develops professional projects by selecting, combining, and using concepts, principles, methodologies and technologies from the field. L.O.1.4 The graduate selects and analyzes bibliographic sources specific to the field. L.O.1.5 The graduate demonstrates autonomy in learning on issues specific to the field. C2. Conducts scientific research. L.O.2.1 The graduate is able to gather information on current vehicle trends and styles and the need for new products or services. L.O.2.2 The graduate is able to conduct research on current and future developments and design trends, as well as related target market characteristics. L.O.2.3 The graduate is able to prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep abreast of recent discoveries. L.O.2.4 The graduate is able to synthesize information, critically interpret and summarize new and complex information from various sources. L.O.2.5 The graduate is able to anticipate changes in automotive technology, monitor and investigate recent technological trends and developments. L.O.2.6 The graduate is able to apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results in terms of relevant estimation of information, as well as related technical systems and their developments. L.O.2.7 The graduate is able to anticipate changes in automotive technology, to monitor and investigate recent technological trends and developments. L.O.2.8 The graduate is able to prepare research documents or give presentations to report the results of a research project carried out, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results. L.O.2.9 The graduate is able to manage data in the field of research.

Transversal competences	Ct1. Self-driving skills and competencies L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Social and communication skills and competencies L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.4 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Apply scientific knowledge to solve automotive engineering problems.
7.2 Specific objectives	• Practical skills for simulating the development processes of automotive products. • Development of programming skills in specific CAD languages. • Theoretical and applicative knowledge related to multibody systems • Practical simulation and analysis skills with MB systems software packages • Theoretical and applied knowledge related to the modeling and simulation of the physical processes • Development of modern software, innovative methods, principles and simulation procedures • Development of methods for evaluating research and development projects • Developing a management strategy using modern principles and methods

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Not the case			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Advanced design and simulation in CATIA V5, using standardized computing, component libraries	Video projector presentations, examples, experiments, case studies related to multibody systems, programming in specific CAD languages, 3D graphic programming	168	
Advanced design elements in CATIA V5 software using appropriate controls			
Development of VRML 3D graphics application for automotive design			
Virtual prototyping using MB systems			
Group projects			
Bibliography 1. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov,			

2016.
2. Gîrbacia, F., Talabă, D., Tehnologiile realității virtuale:lucrări practice, Ed. Universită ii Transilvania Braşov, 2012

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Through its content and through the elaboration of the thematic portfolio (the study), the masters acquire competences in accordance with the expectations of the epistemic community and of the producers in the car market. The analytical program is in line with similar fields addressed at universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course			
10.5 Seminar/ laboratory/ project	Modelling of proposed CAD models	Oral presentation	100%
	Completion of MBS simulation		
	Involvement in practical activities		
	Efficiency in verbal communication (presentation)		
10.6 Minimal performance standard			
• Knowledge of CAD fundamentals • Realization of an MBD simulation for engineering applications • Realization of practical project • The marks for project work must be at least 5.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ, Head of Department**
Prof. Ph. D. eng. Florin GÎRBACIA, **Course holder**	Prof. Ph. D. eng. Florin GÎRBACIA, **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design (in English)

2. Data about the course

2.1 Name of course			Advance Simulation in Automotive Design					
2.2 Course convenor			Prof.dr.ing. Antonya Csaba					
2.3 Seminar/ laboratory/ project convenor			Prof.dr.ing. Antonya Csaba					
2.4 Study year	1	2.5 Semester	2	2.6 Evaluation type	E	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	CFC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/0/2**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/0/28

Time allocation	hours
Study of textbooks, course support, bibliography and notes	70
Additional documentation in libraries, specialized electronic platforms, and field research	75
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	2
Tutorial	2
Examinations	3
Other activities.....	2

3.7 Total number of hours of student activity	154
3.8 Total number per semester	210
3.9 Number of credits[5)]	7

4. Prerequisites (if applicable)

4.1 curriculum-related	• Knowledge of Mathematical Analysis, Special Mathematics
4.2 competences-related	• Basic knowledge of mechanics

5. Conditions (if applicable)

5.1 for course development	• Classroom, video projector
5.2 for seminar/ laboratory/ project development	• Laboratory with computers

6. Specific competences and learning outcomes

Professional competences	C.2 Competences to carry out scientific research. L.O.2.1 To carry out scientific research, to conceive or create new knowledge by formulating questions in the field by researching, improving or developing concepts, theories, models, techniques, tools, software or operational methods and by using methods and techniques scientific; L.O.2.2 To gather information about current trends and styles regarding vehicles and the need for new products or services; L.O.2.3 To prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep up with recent discoveries; L.O.2.4 To prepare research documents or give presentations to report the results of an ongoing research project, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results; L.O.2.5 To synthesize information, critically interpret and summarize new and complex information from various sources; C.4 Skills to use CAD-CAM-CAE systems L.O.4.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.4.2 using computer-aided engineering programs to perform stress analyzes for engineering projects. C.5 Ability to design and develop software L.O.5.1 to develop software for motor vehicles and related systems; L.O.5.2 understand and apply the principles of programming and software development technologies in the automotive industry; L.O.5.3 to evaluate and choose suitable platforms, programming languages and software technologies for projects in the automotive industry; L.O.5.4 to develop software applications to improve the functionality, performance and safety of motor vehicles; L.O.5.5 to test and debug software to ensure the proper and safe operation of vehicle systems; L.O.5.6 to integrate software systems in the global architecture of motor vehicles, taking into account security and compatibility aspects; L.O.5.7 manage automotive software development projects, including planning, budgeting and monitoring progress. C.6 Skills to use CAD-CAM-CAE systems L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.6.2 the use of computer-aided manufacturing (CAM) programs to control machines and machine tools in the creation, modification, analysis or optimization processes as part of the manufacturing processes of motor vehicle parts; L.O.6.3 using computer-aided engineering programs to perform stress analyzes for engineering projects.
Transversal competences	Ct.1 Competences for integration into specific activities at the workplace and technical competencies, in conditions of autonomy and professional independence L.O.1.1 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.2 to show initiative, to be proactive, L.O.1.3 to provide advice to colleagues, offering suggestions on the best way forward; L.O.1.4 to be able to work in a team but also independently develop their own ways of doing things, showing the desire to learn, L.O.1.5 to analyze new problems, based on creative, innovative, analytical, and holistic thinking;

	Ct.2 Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O.2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• The simulation process refers to performing experiments on models of automotive systems to predict how the real system would behave. • Understanding the dynamics of automotive systems and the purpose they serve in designing, analyzing, and controlling them. • Conceptualizing how a system is divided into subsystems and components to allow their synthesis.
7.2 Specific objectives	• Synthesis of mathematical models to represent the automotive systems' dynamic responses for analysis, design, and/or control. • Analysis of the dynamic characteristics of the automotive systems and their responses to inputs. • Methodical system design and synthesis by selecting its parameters to meet the specified criteria. • Control by using sensors and actuators to automate a process or system. • Bond graph representation: structured graphical representation - establishes rules going from the design of models by phenomenological analysis to equation formatting. • Modelling in a non-causal way, allowing focusing on the physical description of the phenomena involved within the automotive systems. • Use of specific software programs for modeling, simulation, and control of integrated systems.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. Introduction to: Modeling vs. Simulation Design, analysis, or control of dynamic systems State-Space Modeling Bond Graphs	The use of classical and multimedia teaching techniques (computer, video projector)	4	
2. Bond Graph Modeling Concepts. Basic Bond Graph Elements Basic bond graph elements: sources, transformers/gyrators, junctions Causal bond graphs Examples	Teaching based on significant examples to provide motivation and explanation of the basic concepts and specific methods, highlighting the relevant ideas	12	
3. Bond Graph Synthesis and Equation Derivation Mathematical modeling of automotive systems Algebraic Loops and Derivative Causality The state space representation		12	

Inputs into dynamic systems Laplace Transforms Transfer Function Impedance Bond Graphs Time domain analysis Frequency domain analysis			
Bibliography Mellodge, Patricia: A Practical Approach to Dynamical Systems for Engineers. Woodhead Publishing, 2016 Javier A. Kypuros: System Dynamics and Control with Bond Graph Modeling. CRC Press, 2013 Dean C. Karnopp, Donald L. Margolis, Ronald C. Rosenberg: System Dynamics Modeling, Simulation, and Control of Mechatronic Systems. John Wiley & Sons, 2012 Claudiu Pozna: Teoria sistemelor automate, Matrixrom, 2010 Antonya, Cs., Boboc, R.G., Mechanisms: theory and examples. Transilvania University Press, Brasov, 2023. François E. Cellier, Ernesto Kofman: Continuous System Simulation, Springer, 2006 Wolfgang Borutzky: Bond Graph Modelling of Engineering Systems, Springer, 2011 Antonya, Cs.: Simularea grafică a sistemelor de corpuri. Transilvania University Press, Braşov, 2004			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Project: 1. Theoretical Subject Write a report of 4-5 pages about the topic from the following list: 1. Bond graph modeling concepts 2. Bond graph elements: mechanical – translational 3. Bond graph elements: mechanical – rotation 4. Bond graph elements: electrical circuits 5. Bond graph elements: flow system 6. Bond graph elements: sources, transformers/gyrators, junctions 7. Causal bond graphs 8. Bond graph synthesis and equation derivation 9. The state space representation 10. Laplace transforms, solving for the system response 11. Impedance bond graphs 12. Time domain analysis 13. Frequency domain analysis 2. Practical subject Simulation in AMESIM or Matlab/Simscape model of an automotive application Write a report about the model with: ◘ Model description ◘ Simulation premises	Experimental activity on system dynamics developed with Siemens AMESim or Matlab/Simscape. Explanations, examples, interactivity, case studies	28	

◘ Initial conditions ◘ Components, ◘ Building the model ◘ Results, interpretation of results			

Bibliography

Mellodge, Patricia: A Practical Approach to Dynamical Systems for Engineers. Woodhead Publishing, 2016
Javier A. Kypuros: System Dynamics and Control with Bond Graph Modeling. CRC Press, 2013
Dean C. Karnopp, Donald L. Margolis, Ronald C. Rosenberg: System Dynamics Modeling, Simulation, and Control of Mechatronic Systems. John Wiley & Sons, 2012
Claudiu Pozna: Teoria sistemelor automate, Matrixrom, 2010
Antonya, Cs., Boboc, R.G., Mechanisms: theory and examples. Transilvania University Press, Brasov, 2023.
François E. Cellier, Ernesto Kofman: Continuous System Simulation, Springer, 2006
Wolfgang Borutzky: Bond Graph Modelling of Engineering Systems, Springer, 2011
Antonya, Cs., Simularea grafică a sistemelor de corpuri. Transilvania University Press, Braşov, 2004

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Studying theoretical subjects and applications ensures the formation of skills related to the integrated design of vehicle systems and understanding the interaction of mechanical systems with electrical/electronic control systems, respectively with hydraulic, pneumatic, thermal systems, etc. These skills are needed in the design and analysis of modern vehicles. Completing the course involves knowing and using software tools for designing modern mechanical systems in an integrated and optimal approach.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Using basic knowledge to explain and interpret algorithms for multibody systems	Oral examination	33%
10.5 Seminar/ laboratory/ project	According to the project subject (theoretical and simulation)	Presentation	67%
10.6 Minimal performance standard			
• Use basic knowledge to explain and interpret the vehicle's dynamic systems. • Elaboration of a project with an imposed theme, • The grades obtained for the imposed subject, project, and exam must be at least 5.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	Prof.dr.ing. Mihai DUGULEANĂ, Head of Department

Prof.dr.ing. Csaba ANTONYA, **Course holder**	Prof.dr.ing. Csaba ANTONYA, **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Simulation in product development					
2.2 Course convenor			Prof.dr.ing. BUTNARIU Silviu					
2.3 Seminar/ laboratory/ project convenor			Prof.dr.ing. BUTNARIU Silviu					
2.4 Study year	1	2.5 Semester	2	2.6 Evaluation type	V	2.7 Course status	Content[3)]	DS
							Attendance type[4)]	DI

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**2**	out of which: 3.2 lecture	**1**	3.3 seminar/ laboratory/ project	**0/0/1**
3.4 Total number of hours in the curriculum	28	out of which: 3.5 lecture	14	3.6 seminar/ laboratory/ project	0/0/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	32
Additional documentation in libraries, specialized electronic platforms, and field research	28
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	28
Tutorial	2
Examinations	2
Other activities.....	

3.7 Total number of hours of student activity	92
3.8 Total number per semester	120
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Engineering disciplines studied in the undergraduate years
4.2 competences-related	• Basic engineering concepts

5. Conditions (if applicable)

5.1 for course development	• classroom, projector
5.2 for seminar/ laboratory/ project development	• computer room.

6. Specific competences and learning outcomes

Professional competences	C.1 Skills for identifying needs for design L.O.1.1 To identify customer needs; L.O.1.2 To interpret the technical requirements of customers, analyzing, understanding and applying the information provided regarding the technical conditions; L.O.1.3 To define technical design requirements, C.6 Skills to use CAD-CAM-CAE systems L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.6.3 using computer-aided engineering programs to perform stress analyzes for engineering projects. C.7 Competences for the development of vehicle manufacturing and assembly technologies, test and validation procedures for vehicle components, systems and equipment L.O. 7.2 evaluation of advanced vehicle manufacturing technologies and their correlation with the optimal operating parameters of vehicle systems; L.O.7.6 development of test and validation protocols to enable a variety of analyzes of vehicle components and systems; L.O.7.8 identifying problems that may arise and finding optimal solutions; R.Î.7.10 evaluating the possibility that a system or its components can be obtained by applying certain engineering principles. C.8 The ability to improve safety and comply with technical equipment safety standards L.O.8.2 combine mechanical, electrical, electronic, software and safety engineering for vehicle design.
Transversal competences	CT.1 Competences for integration into specific activities at the workplace and technical competences, in conditions of autonomy and professional independence L.O.1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.6 to be able to work in a team but also independently, developing their own ways of doing things, showing the desire to learn, L.O.1.7 to analyze new problems, based on creative, innovative, analytical, holistic thinking; L.O. 1.9 apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.13 to plan activities, manage the calendar and resources to complete tasks in a timely manner. CT.2 Communication and teamwork skills L.O.2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	Theoretical and applied training in the design and development of products in the field of motor vehicles
7.2 Specific objectives	• Understanding product development strategies • Understanding of product design methods and processes • Understanding and practicing simulation in product development

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Trends in the automotive industry. Life cycle assessment	Interactive course, exposure to	2	
Product development in the automotive industry. Introduction		2	

(background, methods, history)	multimedia		
Life cycle of automotive products		2	
Product development process models. Simulation in product development		4	
Project management in product development		2	
How product development simulation adds value to the product development process		2	
Bibliography Rafinjad, D. R. *Innovation, product development and Commercialization*, 2007 Munch, J., a o , *Software process definition and Management,* Springer, 2012 Karniel, A., Reich Y., *Managing the Dynamics of the New Product Development Process*, Springer, 2011.			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Product development processes for public transport systems: case studies of electromobility systems; infrastructure; monitoring; efficiency; innovation process, research activities.	Individual and group work, assisted training	6	
Product Development Simulation Case Studies: Global Customer Demands: Model Supported Design vs Traditional Design; model validation; virtual model verification, applications on automotive engine subassemblies	Individual and group work, assisted training	8	
Bibliography Rafinjad, D. R. *Innovation, product development and Commercialization*, 2007 Munch, J., a o , *Software process definition and Management,* Springer, 2012 Karniel, A., Reich Y., *Managing the Dynamics of the New Product Development Process*, Springer, 2011.			

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

The content of the discipline was discussed with the professors of the department and with the representatives of the Schaeffler Romania company

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Ability to identify, formulate and solve engineering problems	Knowledge verification to support the project	50
10.5 Seminar/ laboratory/ project	Correctness of schemes and calculations and conclusions	Project analysis	30
	The originality of the presentation.	Powerpoint presentation	20
10.6 Minimal performance standard			
• Grade 5 on the project • Score 5 on the knowledge test			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA Dean of Faculty of Mechanical Engineering	Prof.dr.ing. Mihai DUGULEANĂ Head of Department
Prof.dr.ing. Silviu BUTNARIU Course holder	dr.ing. Eugen BUTILĂ Holder of laboratory/ project

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course				Finite element analysis in automotive design (FEA)				
2.2 Course convenor				Prof.dr.ing. BUTNARIU Silviu				
2.3 Seminar/ laboratory/ project convenor				dr.ing. BUTILĂ Eugen				
2.4 Study year	1	2.5 Semester	2	2.6 Evaluation type	E	2.7 Course status	Content[3)]	DAP
							Attendance type[4)]	DI

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/1/1**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/14/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	45
Additional documentation in libraries, specialized electronic platforms, and field research	40
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	28
Tutorial	8
Examinations	3
Other activities.....	

3.7 Total number of hours of student activity	124
3.8 Total number per semester	180
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• General concepts of physics, mechanics, strength of materials. Mathematical disciplines and engineering disciplines (machine parts, material resistance, mechanics, mechanisms), studied in the undergraduate years
4.2 competences-related	Knowledge and understanding: • familiarize students with the concepts and terminology of the discipline, with reference to mechanical systems and processes in the field of automotive engineering study. • understanding the reasoning used and how the investigation; • understanding criteria for choice and use of methods of investigation. Explanation and interpretation: • explain the concepts used in finite element analysis and interpretation of analysis results of tension and strain generated in different application situations; Instrumental – Applied

	• to selection of the concepts and proper investigation methods, recognizing how best to resolve the problem subject to study; • proper use of specific calculation processes theory finite element discretization of a correct interpretation of results, proper use of the automatic calculation program for. Attitude • evidence of positive and responsible attitudes towards science based on knowledge of phenomena and connections with engineering practice; • fostering scientific environment centered democratic values and relationships; • making best use of their potential in creative and scientific activities; • engaging in a partnership relationship with other people: colleagues, teachers, etc. participation in their scientific development.

5. Conditions (if applicable)

5.1 for course development	• classroom, projector
5.2 for seminar/ laboratory/ project development	• computer room, dedicated software (ANSYS), machine elements.

6. Specific competences and learning outcomes

Professional competences	C.2 Competences to design systems, equipment and vehicle components L.O.2.3 applying mathematical methods and using calculation and simulation programs to perform technical analyzes and design solutions for specific problems; L.O.2.5 designing prototypes of vehicle components and systems by applying advanced engineering principles; L.O.2.6 preparation of functional models, prototypes in order to test concepts and reproduction possibilities; creating prototypes for pre-production test evaluation; L.O.2.7 development of test protocols for vehicle components and equipment; C.4 Competences to carry out scientific research. L.O 4.3 To prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. L.O.4.4 To prepare research documents or give presentations to report the results of an ongoing research project, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results; L.O.4.9 To synthesize information, critically interpret and summarize new and complex information from various sources; C.6 Skills to use CAD-CAM-CAE systems L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.6.3 using computer-aided engineering programs to perform stress analyzes for engineering projects.

Transversal competences	CT.1 Competences for integration into specific activities at the workplace and technical competences, in conditions of autonomy and professional independence L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O.1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.13 to plan activities, manage the calendar and resources to complete tasks in a timely manner. CT.2 Communication and teamwork skills L.O.2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	The study of the Finite Element Method discipline has as its general objective the acquisition of knowledge and the acquisition of the skills necessary for professional development in the environment of industrial codes and, in particular, to form the skills necessary for the design and computer-assisted manufacturing activities of specific engineering milestones
7.2 Specific objectives	In this course, the fundamental aspects of the finite element method are first presented, then the student becomes familiar with the use of basic tools for finite element modelling and analysis, applied in the real situation of some engineering problems. The educational purpose of the course aims at the following objectives: • Knowledge and appropriate use of the concepts with which the discipline operates: finite element, model with finite elements, elementary stiffness matrix, global stiffness matrix, boundary conditions, processing, post-processing, etc.; • Understanding the principles of modelling resistance structures and their elements, as well as developing the skills of correct application of this knowledge; • Carrying out pertinent analyses regarding the schematization level accepted when developing a model with finite elements in structural mechanics problems; • The correct interpretation of the results and the formulation of conclusions based on the results obtained following the analysis on models with finite elements;

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. The finite element method: The principle of the finite element method, the steps to solve a problem using the finite element method, shape functions, general considerations on the choice of elemental elements, meshing domain analysis for continuous structures, obtaining finite element numerical model.	Interactive course, exposure to multimedia, heuristic conversation, explanation, demonstration	4	
2. One-dimensional problems		2	
3. Multidimensional problems		2	
4. Calculation methods of engineering structures. Using finite element method in engineering. Physical and Engineering Opportunities limits.		2	
5. Basis of the theory of elasticity: tension, displacement fields		4	

and strain states;			
6. Laws of behavior / criteria limits of elasticity: Tresca criterion, Von Mises criterion.		4	
7. Mechanical Fundamentals of finite element method. Balance equations. Laws of behaviour. Approximation by finite elements. The finite element method in elasticity, led by displacement calculation, deformation tensor, vector efforts, the element stiffness matrix.		2	
8. Types of finite elements and criteria of their choice. Practical problems using the finite element method. Influence of mesh, test case.		4	
9. Case study for a bar subjected to bending.		2	
10. Steps for the finite element analysis and the flowchart for solving process. Interpretation of finite element analysis results.		2	
Bibliography Butnariu, S., Mogan, Gh., Analiza cu elemente finite în ingineria mecanicã. Aplicatii practice in ANSYS, Ed. Universită ii Transilvania, ISBN 978-606-19-0474-7 (print), 2014			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
1. Description the possibilities and the performances calculation used programs.	Learning through problem / explanation, demonstration, case study, conducting guided and independent applications.	2	14 case studies – tutorials from references
2. Analysed the structure geometry modelling: Defining mesh parameters. Choice of finite element. Discretization.		3	
3. Physical and mechanical modelling: Defining material. Defining and declaring links. Defining external actions - forces and moments - and load situations.		3	
4. Finite element analysis: static calculation, calculation of dynamic		3	
5. Finite element analysis results. Interpretation and exploitation.		1	
6. Assessment of laboratory activity and project evaluation		2	
7. Project – finite element analysis of an element / assembly	Solving a case study	14	
Bibliography Butnariu, S., Mogan, Gh., Analiza cu elemente finite în ingineria mecanicã. Aplicatii practice in ANSYS, Ed. Universității Transilvania, ISBN 978-606-19-0474-7 (print), 2014			

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Finite element analysis software applications offer a wide range of solutions in industry, for example in civil construction infrastructure: power plants, bridges, roads, railways, structures, and water systems. Benefits include: greater confidence in the structural integrity of the design when considering multiple innovative construction methods and materials, rapid evaluation of trade studies, configuration changes, concept drawings, side-by-side evaluation of the overall structure, with details key within the structure, as well as the ability to cope with all types of loading environments.

A large proportion of representative employers recognize that modeling and simulation, including finite element analysis (FEA) and computer-aided design (CAD), are valuable tools in vehicle development to optimize design and minimize risk. Using simulation tools including ADAMS, MATLAB, as well as finite element analysis, these companies provide rapid design coupled with corrective action.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Ability to apply knowledge of mathematics, science and engineering. Ability to identify, formulate and solve engineering problems	Testing theoretical and practical knowledge by carrying out a complex project - case study	50
10.5 Seminar/ laboratory/ project	Ability to complete, follow and complete case studies solvable through MEF based on tutorials.	Studying and solving laboratory work	15
	Ability to use modern engineering techniques, skills and tools required for engineering practices; case study.	Practical test - solving exercises	35
10.6 Minimal performance standard			
• Minimum requirements for grade 5: for all evaluation activities, at least half of the points awarded, respectively minimum grade 5, must be obtained. The minimum performance standards are given by understanding the introductory concepts taught in each topic, making the connection between concepts, the correct approach to the applications and calculation dexterity			

This course outline was certified in the Department Board meeting on 20/092024 and approved in the Faculty Board meeting on 30/09/2024.

Prof.dr.ing. Ioan Călin ROȘCA Dean of Faculty of Mechanical Engineering	Prof.dr.ing. Mihai DUGULEANĂ Head of Department
Prof.dr.ing. Silviu BUTNARIU Course holder	dr.ing. Eugen BUTILĂ Holder of laboratory/ project

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Virtual and augmented reality in automotive design and maintenance					
2.2 Course convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.3 Seminar/ laboratory/ project convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	1	2.5 Semester	2	2.6 Evaluation type	E	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	CPC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**3**	out of which: 3.2 lecture	**1**	3.3 seminar/ laboratory/ project	**0/1/1**
3.4 Total number of hours in the curriculum	42	out of which: 3.5 lecture	14	3.6 seminar/ laboratory/ project	0/14/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	25
Additional documentation in libraries, specialized electronic platforms, and field research	35
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	52
Tutorial	22
Examinations	2
Other activities.....	2

3.7 Total number of hours of student activity	138
3.8 Total number per semester	180
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• Knowledge of 3D Modelling, 3D Graphics Programming
4.2 competences-related	• Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 for course development	• projector • lecture notes • recommended bibliography
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • virtual and augmented reality equipments • lecture notes • recommended bibliography

6. Specific competences and learning outcomes

Professional competences	Cp1 Design the user interface L.O.1.1 The graduate has in-depth knowledge of the principles of Human-Computer Interaction (HCI) and ergonomics: HCI models and theories (conceptual, cognitive and perceptual models that underlie human interaction with technology), UI/UX design principles (Deep knowledge of the principles of usability (ease of use), user experience (user experience), accessibility and consistency in interface design), cognitive and physical ergonomics. L.O.1.2 The graduate has the ability to analyze the requirements and project specification. L.O.1.3 The graduate has the ability to design information architecture, user flows, wireframes and prototypes of intuitive and efficient interfaces. L.O.1.4 The graduate has the ability to integrate software components with hardware specific to systems or machines (e.g. sensors, actuators, displays, buttons), using appropriate drivers and APIs. L.O.1.5 The graduate assumes full responsibility for the quality, performance and security of the developed interface components. L.O.1.6 The graduate has the ability to adapt quickly to new requirements, technologies or changes in project specifications. L.O.1.7 The graduate demonstrates initiative in exploring and implementing innovative solutions to improve human-system/machine interaction. Cp2. Design and execute the virtual model of a product L.O.2.1 The graduate will demonstrate in-depth knowledge of the fundamental principles of computational geometry and the mathematical representation of three-dimensional shapes, the differences and applications of wireframe, surface and solid models, as well as the concepts of parametric and direct modeling. L.O.2.2 The graduate has the ability to fluently use CAE/CAD software to create 3D models: This includes modeling complex parts, assemblies, generating technical drawings and applying geometric constraints and relationships. L.O.2.3 The graduate has the ability to optimize product design based on simulation results to improve the performance, reliability or efficiency of an automotive component or system. L.O.2.4 The graduate has the ability to integrate various software tools and manage data transfer between them. L.O.2.5 The graduate will demonstrate autonomy in choosing appropriate modeling tools and methods. L.O.2.6 The graduate will demonstrate a proactive attitude in solving problems, by identifying and addressing technical challenges related to modeling and simulation, seeking innovative and effective solutions. Cp3. Uses application-specific interfaces L.O.3.1 The graduate can evaluate and choose platforms, programming languages, and software technologies suitable for automotive industry projects. L.O.3.2 The graduate has the ability to understand and apply the principles of programming and software development technologies in the automotive industry. L.O.3.3 The graduate has the ability to manage automotive software development projects, including planning, budgeting, and monitoring progress.

Transversal competences	Ct1. Self-driving skills and competencies L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Social and communication skills and competencies L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.4 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Understanding the principles and potential for automotive design of Virtual Reality (VR) and Augmented Reality (AR) techniques and technologies. • Understand and gain basic knowledge required to develop applications for 3D simulation of automotive based on VR technology.
7.2 Specific objectives	• Learning of knowledge for creating interactive 3D virtual environments required in automotive design; • Learning knowledge for development of RV / RA software; • Acquisition of practical skills for automotive design applications through the use of RV / RA technologies and programming environments.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Introduction. The aim of the course. Introduction to human-computer interaction. Terminology, definitions and characteristics of virtual reality. Terminology, definitions and characteristics of augmented reality. Available technologies for virtual reality and augmented. History of virtual and augmented reality.	Interactive lecture	2 hours	
Software systems and standards for virtual and augmented reality: Unity, InstantReality, ARCore	Interactive lecture	2 hours	
Virtual and augmented reality hardware: technology and stereoscopic 3D visualization systems, haptic and audio systems	Interactive lecture	2 hours	
Virtual and augmented reality hardware: 3D input devices for virtual reality: tracking systems, voice commands, gloves, brain-computer interfaces.	Interactive lecture	2 hours	
3D interaction techniques for virtual and	Interactive lecture	2 hours	

augmented reality.			
Designing RV/RA user interfaces and applications	Interactive lecture	4 hours	

Bibliography

1. Gîrbacia Florin, Duguleană Mihai (2019): Virtual and augmented reality in automotive design and maintenance: course notes, Editura Universitatii Transilvania din Brasov, ISBN 978-606-19-1124-0.
2. Gîrbacia F. (2016): Tehnologii de Realitate Virtuală și Augmentată Aplicate în Inginerie. Note de curs", Editura Universitatii Tranilvania din Brasov, ISBN 978-606-19-0784-7.
3. Talabă, D., Amditis, A. Product Engineering, Tools and Methods Based on Virtual Reality. Editura Springer, 2007.
4. Gîrbacia, F. Talabă, D., Tehnologiile realității virtuale:lucrări practice, Editura Universității Transilvania Braşov, 2012.
5. Girbacia, F. Cercetari teoretice si experimentale privind dezvoltarea de interfete multimodale de realitate virtuala pentru aplicatii de proiectare asistata de calculator,Teza de doctorat,Universitatea Transilvania Brasov, 2007.
6. Vince J., Realitate Virtuala, Editura Tehnica, Bucuresti, 2000.
7. Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, Ivan Poupyrev, "3D User Interfaces: Theory and Practice", Addison-Wesley/Pearson Education, 2005,ISBN 0-201-75867-9.
8. Burdea, G. Virtual Reality Technology, Ed. John Wiley&Sons, 2003.

Thalman, D. Stepping into Virtual Reality, Ed. Springer, 2008.

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Geometric modeling of 3D virtual environments for automotive design applications.	Interactive lecture, exercises and examples, individual work	2 hours	
Techniques and principles for developing virtual reality applications using Unity	Interactive lecture, exercises and examples, individual work	4 hours	
Techniques and principles for developing applications using the, Unity, Instant Reality and ArCore SDK Augmented Reality libraries	Interactive lecture, exercises and examples, individual work	4 hours	
Development of 3D stereoscopic passive / active visualization automotive design applications.	Interactive lecture, exercises and examples, individual work	4 hours	
Navigation and interaction in virtual three-dimensional VRML scenes using 3D mouse and joystick	Interactive lecture, exercises and examples, individual work	2 hours	
Designing a with 1 DOF haptic device for an automotive part design haptic prototyping	Individual work	6 hours	
Development of a Augmented Reality Application for automotive maintenance interactive instructions	Individual work	6 hours	

Bibliography

1. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
2. Gîrbacia Florin, Duguleană Mihai (2019): Virtual and augmented reality in automotive design and maintenance: course notes, Editura Universitatii Transilvania din Brasov, ISBN 978-606-19-1124-0.
3. Gîrbacia, F., Talabă, D., Tehnologiile realității virtuale:lucrări practice, Ed. Universită ii Transilvania Braşov,

2012.
4. Gîrbacia F. (2016): Tehnologii de Realitate Virtuală și Augmentată Aplicate în Inginerie. Note de curs", Editura Universitatii Tranilvania din Brasov, ISBN 978-606-19-0784-7.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Cunoştin ele teoretice și practice fundamentează cele mai noi abordări ale tehnologiilor de Realitate Virtuală și Augmentată pentru domeniul proiectării autovehiculelor. Programa analitică este în concordan ă cu domeniile similare abordate la universități din țară și din străinătate.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Ability to configure virtual reality systems for engineering	Written exam	40%
10.5 Seminar/ laboratory/ project	Ability to use modern virtual reality techniques and technologies	Solving practical applications	60%
10.6 Minimal performance standard			
• Knowledge of the fundamentals of VR/RA technologies • Development of an RV/RA application for automotive engineering • The grades obtained for the project and exam activity must be at least 5			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, ... **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** ..... **Head of Department**
Prof. Ph. D. eng. Florin GÎRBACIA, ... **Course holder**	Prof. Ph. D. eng. Florin GÎRBACIA, ... **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

[3] Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Practice for research and development I					
2.2 Course convenor								
2.3 Seminar/ laboratory/ project convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	1	2.5 Semester	2	2.6 Evaluation type	C	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	**NCPC**

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**12**	out of which: 3.2 lecture	**0**	3.3 seminar/ laboratory/ project	**0/0/12**
3.4 Total number of hours in the curriculum	168	out of which: 3.5 lecture	0	3.6 seminar/ laboratory/ project	168

Time allocation	hours
Study of textbooks, course support, bibliography and notes	
Additional documentation in libraries, specialized electronic platforms, and field research	
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	
Tutorial	
Examinations	
Other activities.....	

3.7 Total number of hours of student activity	168
3.8 Total number per semester	168
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Elementary concepts of automotive engineering, computer-aided design
4.2 competences-related	• Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 for course development	• projector
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • Windows operating system, Unity 3D, Ansys

6. Specific competences and learning outcomes

Professional competences	C1. Automobile Construction L.O.1.1 The graduate identifies and explains the basic concepts, theories and methods of the field of automotive engineering and the specialization. L.O.1.2 The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. L.O.1.3 The graduate develops professional projects by selecting, combining, and using concepts, principles, methodologies and technologies from the field. L.O.1.4 The graduate selects and analyzes bibliographic sources specific to the field. L.O.1.5 The graduate demonstrates autonomy in learning on issues specific to the field. C2. Conducts scientific research. L.O.2.1 The graduate is able to gather information on current vehicle trends and styles and the need for new products or services. L.O.2.2 The graduate is able to conduct research on current and future developments and design trends, as well as related target market characteristics. L.O.2.3 The graduate is able to prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep abreast of recent discoveries. L.O.2.4 The graduate is able to synthesize information, critically interpret and summarize new and complex information from various sources. L.O.2.5 The graduate is able to anticipate changes in automotive technology, monitor and investigate recent technological trends and developments. L.O.2.6 The graduate is able to apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results in terms of relevant estimation of information, as well as related technical systems and their developments. L.O.2.7 The graduate is able to anticipate changes in automotive technology, to monitor and investigate recent technological trends and developments. L.O.2.8 The graduate is able to prepare research documents or give presentations to report the results of a research project carried out, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results. L.O.2.9 The graduate is able to manage data in the field of research.
Transversal competences	Ct1. Self-driving skills and competencies L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Social and communication skills and competencies L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.4 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Apply scientific knowledge to solve automotive engineering problems.
7.2 Specific objectives	• Practical skills for operating and use the RV hard-software systems. • Practical skills for simulating the development processes of automotive products. • Practical skills of advanced simulation in the design of vehicles • Theoretical and applied knowledge related to the modeling and simulation of the physical processes • Development of modern software, innovative methods, principles and simulation procedures • Development of methods for evaluating research and development projects • Developing a management strategy using modern principles and methods

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Not the case			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Development of a passive / active 3D stereoscopic visualization application related to automotive design	Video projector presentations, examples, experiments, case studies related to multibody systems, programming in specific CAD languages, 3D graphic programming	168	
Developed RV / RA application for maintenance of autovehicles			
Performing a finite element analysis in Ansys of a vehicle component			
Group projects			

Bibliography

1. Gîrbacia Florin –„Tehnologii de realitate virtuală pentru proiectarea asistată de calculator", Editura Universitatii Transilvania, 2019. ISBN 978-606-19-1123-3
2. Gîrbacia Florin, Duguleană Mihai – „Virtual and augmented reality in automotive design and maintenance: course notes", Editura Universitatii Transilvania din Brasov, 2019. ISBN 978-606-19-1124-0
3. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
4. Gîrbacia, F., Talabă, D., Tehnologiile realității virtuale:lucrări practice, Ed. Universită ii Transilvania Braşov, 2012.
5. Gîrbacia F. (2016): Tehnologii de Realitate Virtuală și Augmentată Aplicate în Inginerie. Note de curs", Editura Universitatii Tranilvania din Brasov, ISBN 978-606-19-0784-7.
6. Butnariu, S., Mogan, Gh., Analiza cu elemente finite în ingineria mecanică. Aplicatii practice in ANSYS, Ed. Universită ii Transilvania, ISBN 978-606-19-0474-7 (print), 2014

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Through its content and through the elaboration of the thematic portfolio (the study), the masters acquire competences in accordance with the expectations of the epistemic community and of the producers in the car market. The analytical program is in line with similar fields addressed at universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course			
10.5 Seminar/ laboratory/ project	RV application development	Oral presentation	100%
	FEM simulation completion		
	Involvement in practical activities		
	Efficiency in verbal communication (presentation)		
10.6 Minimal performance standard			
• Knowledge of CAD fundamentals • Realization of an MBD simulation for engineering applications • Realization of practical project • The marks for project work must be at least 5.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** **Head of Department**
Prof. Ph. D. eng. Florin GÎRBACIA, **Course holder**	Prof. Ph. D. eng. Florin GÎRBACIA, **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

A. COURSE OUTLINE

1. Program data

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Motor vehicles and transport
1.4 Master's field of study [1)]	Automotive Engineering
1.5 Cycle of studies[2)]	Masters
B. 1.6 Curriculum/Qualification	Virtual Engineering in Automotive Design / Master's Degree

2. Discipline data

2.1 Name of the discipline	Advanced mechanical transmissions in automotive engineering							
2.2 Course Activity Holder				Conf.dr.ing. Dragoș Sorin Dima				
2.3 Owner of project activities				Conf.. dr.ing. Dragoș Sorin Dima				
2.4 Year of study	1	2.5 Semester	2	2.6 Type of assessment	V	2.7 Discipline regime	Content3)	DAP
							Obligation4[)]	DO

3. Total estimated time (hours per semester of teaching activities)

3.1 Number of hours per week	**2**	of which: 3.2 course	**1**	3.3 Seminar/ Laboratory/ Project	**0/0/1**
3.4 Total hours of the curriculum	28	of which: 3.5 course	14	3.6 Seminar/ Laboratory/ Project	0/0/14

Time Pool Distribution	hours
Study by textbook, course material, bibliography and notes	15
Additional documentation in the library, on specialized electronic platforms and in the field	15
Preparation of seminars/laboratories/projects, assignments, papers, portfolios and essays	28
Tutoriat	2
Examination	2
Other activities.....	

3.7 Total hours of student activity	62
3.8 Total hours per semester	90
3.9 Number of credits5)	3

4. Preconditions (where applicable)

4.1 curriculum - related	General concepts of physics, mechanics, strength of materials. Mathematical disciplines and engineering disciplines (machine parts, material resistance, mechanics, mechanisms), studied in the undergraduate years
4.2 Competences	Knowledge and understanding: ◘ familiarize students with the concepts and terminology of the discipline, with reference to mechanical systems and processes in the field of automotive engineering study. ◘ understanding the reasoning used and how the investigation; ◘ understanding criteria for choice and use of methods of investigation. Explanation and interpretation: ◘ explain the concepts used in finite element analysis and interpretation of analysis results of tension and strain generated in different application situations;

	Instrumental – Applied ◘ to selection of the concepts and proper investigation methods, recognizing how best to resolve the problem subject to study; ◘ proper use of specific calculation processes theory finite element discretization of a correct interpretation of results, proper use of the automatic calculation program for. Attitude ◘ evidence of positive and responsible attitudes towards science based on knowledge of phenomena and connections with engineering practice; ◘ fostering scientific environment centered democratic values and relationships; ◘ making best use of their potential in creative and scientific activities; ◘ engaging in a partnership relationship with other people: colleagues, teachers, etc. participation in their scientific development.

5. Conditions (where applicable)

5.1 for course development	classroom, projector
5.2 for seminar/ laboratory/ project	computer room, dedicated software (ANSYS), machine elements.

6. Specific competences and learning outcomes

	CP2. Skills in the design of systems, equipment and components of motor vehicles L.O.2.1 the ability to study, interpret and capitalize on the technical resources specific to the automotive manufacturing industry; L.O.2.2 the use of advanced concepts, techniques and principles for the design of modern automotive systems and equipment; L.O.2.3 the application of mathematical methods and the use of calculation and simulation programs to perform technical analyses and design solutions for specific problems; L.O.2.5 Prototype design of automotive components and systems by applying advanced engineering principles; **CP4 Competences to carry out scientific research** L.O.4.1 To conduct scientific research, to conceive or create new knowledge by formulating questions in the field by researching, improving or developing concepts, theories, models, techniques, tools, software or operational methods and by using scientific methods and techniques; L.O.4.2 Gather information about current vehicle trends and styles and the need for new products or services; L.O.4.3 Prepare reports describing the results and processes of scientific or technical research or assessing its progress. These reports help researchers keep up with recent findings; L.O.4.4 Develop research papers or give presentations to report the results of a research project, indicating the analysis procedures and methods that led to those results, as well as possible interpretations of the results; L.O.4.5 Conduct research on present and future developments and trends in design, as well as related target market characteristics; L.O.4.6 Anticipate changes in automotive technology, supervise and investigate recent technological trends and developments; L.O.4.7 Manage research data;

6. Specific competences accumulated (according to the competence grid of the curriculum)	L.O.4.9 Synthesize information, interpret and critically summarize new and complex information from various sources; L.O.4.10 Interact professionally in research and professional environments; L.O.4.11 Apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results with a view to relevant estimation of the information, as well as related technical systems and their developments; L.O.4.12 Demonstrate in-depth knowledge and complex understanding of the field of research, including responsible research, ethical principles and scientific integrity in research, respect for privacy and GDPR requirements, related to research activities in a particular discipline. **CP.6 Competences for the use of CAD-CAM-CAE systems** L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimisation of an industrial design; **CP.7 Competences for the development of motor vehicle manufacturing and assembly technologies, test and validation procedures for motor vehicle components, systems and equipment** L.O.7.2 Evaluation of advanced technologies for the manufacture of motor vehicles and their correlation with the optimal operating parameters of motor vehicle systems; L.O.7.3 applying and developing specific criteria, procedures and methods for the design of modern manufacturing, assembly and maintenance technologies for motor vehicles;
Transversal competences	**CT.1 Integration skills in specific activities at the workplace and technical skills, in conditions of autonomy and professional independence** L.O.1.1 to take responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O.1.2 to show determination, making sustained efforts for success by pursuing clear objectives, to make decisions by choosing from several alternative possibilities; L.O.1.3 show initiative, be proactive, L.O.1.4 to show self-reflection, quick thinking and to accept criticism and new guidance received from colleagues or superiors; L.O.1.5 provide advice to co-workers, providing suggestions on the best way forward; L.O.1.6 to be able to work in a team but also independently by developing their own ways of doing things, showing a willingness to learn, L.O.1.7 to analyse new problems that have arisen, based on creative, innovative, analytical, holistic thinking; L.O.1.8 to ensure customer orientation; R.Î.1.9 to apply scientific, technological and engineering knowledge, processing complex information; L.O.1.10 to identify problems and make decisions to solve them; L.O.1.11 to apply principles, policies and regulations aimed at environmental sustainability, including the reduction of waste, energy and water consumption, the reuse and recycling of products, as well as involvement in the collaborative economy; L.O.1.12 to comply with the rules, regulations and guidelines relating to a particular field or sector and to apply them in its day-to-day work; L.O.1.13 plan activities, manage the calendar and resources to complete tasks in a timely manner.

	CT.2 Communication and teamwork skills L.O.2.1 to carry out their work in a team; R.Î.2.2 to address an audience, to give a speech, to make a presentation; L.O.2.3 moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts; L.O.2.6 to be able to lead others, to coordinate a team; L.O.2.7 be able to train other team members and organize information, objects and resources; L.O.2.8 to motivate others, stimulating action; L.O.2.9 to develop teams, managing time and delegating responsibilities;

7. Objectives of the discipline (resulting from the specific skills accumulated)

7.1 General objective of the discipline	Theoretical and applicative training in the construction and operation of motor vehicle transmissions. In-depth theoretical and applied training in the design and development of automotive transmissions. Theoretical and applicative training in understanding the physical processes of mechanical transmissions controlled by mechatronic systems.
7.2 Specific objectives	Introduction of master's students to the fundamental concepts of modern transmissions for motor vehicles. Understanding the structures and functionalities of automatic transmissions. Understanding the methods and algorithms of designing automatic transmissions. Theoretical and applied knowledge related to all stages of product development (conception, design, manufacture, operation). Practical skills in approaching automotive product development processes. Development of automatic transmission design skills. Improve your CAD modeling and calculation skills with software packages. Practical skills for studying the behavior of mechanical systems controlled by mechatronic devices.

8. Content

8.1 Course	Teaching methods	Number of hours	Observations
Motor vehicle transmissions (operating principles, terminology, classification, development trends).	Lecture, discussions	2	
Kinematics and dynamics of planetary mechanisms.		2	
Automatic planetary transmissions.		2	
Mechanical friction transmissions with continuously variable gear ratio (CVT).		2	
Hydromechanical transmissions (with hydrodynamic and hydrostatic variators).		2	
Controlled torque distribution systems. All-wheel drive.		2	
Hybrid powertrains.		2	
Bibliography Preda I. Transmisii mecanice avansate în ingineria automobilului. http://elearning.unitbv.ro Fischer, R., Küçükay, F., Jürgens, G., Najork, R. and Pollak, B. The Automotive Transmission Book. Powertrain: Springer,			

2015.
Naunheimer,H. Bertsche,B. Ryborz,J. Novak,W. Automotive Transmissions - Fundamentals, Selection, Design and Application. Ed. Springer, London, 2011.
Crolla,D. Automotive Engineering – Powertrain, Chassis System and Vehicle Body. Ed. Butterworth-Heinemann, 2009.
Genta,G. Morello,L. The Automotive Chassis. Vol. 1: Components Design. Ed.Springer, 2009.
Genta,G. Morello,L. The Automotive Chassis. Vol. 2: System Design. Ed.Springer, 2009.
Ehsani,M. Gao,Y. Gay,S. Emadi,A. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles – Fundamentals, Theory, and Design. CRC Press, 2005.
Reik,W. Reitz,D. Vornehm,M. World of hybrids. Schaeffler Symposium 2006, pp.171-187.
Husain,I. Electric and Hybrid Vehicles Design Fundamentals. CRC Press, Taylor & Francis Group, 2005.
Heisler,H. Advanced Vehicle Technology. Butterworth-Heinemann (Elsevier), 2002.
Reimpell,J. Stoll,H. Betzler,J. The Automotive Chassis: Engineering Principles. SAE International; Butterworth-Heinemann (Elsevier), 2001.
Lechner,G. Naunheimer,H. Automotive Transmissions – Fundamentals, Selection, Design and Application. Ed. Springer, 1999.
Fenton,J. Handbook of automotive powertrains and chassis design. Professional Engineering Publishing, London, 1998.
*** Bosch Automotive Handbook. 11th Edition, Plochingen, Germany, 2022.
Macarie,T.N. Vieru,I. Bădărău-Suster,H. Transmisii automate, automatizate si continue pentru automobile. Ed. PIM Iași, 2018.
Preda,I. Ciolan,Gh. Diaconescu,E. Cristea,D. Transmisii cu varia ie continuă pentru autovehicule. Editura Universită ii din Piteşti, 2012.
Năstăsoiu,M. Pădureanu,V. Tractoare. Ed. Univ. Transilvania, 2012.
Preda,I. Roşca,G.M. Tehnici neconven ionale în propulsia autovehiculelor – Poten ialul surselor regenerabile de energie în Uniunea Europeană şi în România. Editura Universită ii din Oradea, 2011.
Livin ,Gh. Gaiginschi,R. Horga,V. Drosescu,R. Chiriac,G. Albu,M. Rădoi,M. Damian,I. Petrescu,M. Vehicule electrice hibride. Editura Venus, Iaşi, 2006.
Macarie,T.N. Transmisii continue pentru autovehicule. Ed. Universită ii din Piteşti, 1999.
Tabacu I. Transmisii mecanice pentru autoturisme. Editura Tehnică, Bucureşti, 1999.
Ciolan,Gh. Preda,I. Pereş,Gh. Cutii de viteze pentru automobile. Editura Didactică şi Pedagogică, Bucureşti, 1998.

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Observations
Calculation of transmission ratios and torque moments for a planetary transmission with chosen kinematic scheme	Individual and group work, assisted training		
Presentation of the project requirements; Initial documentation		2	
Finalization of the topic; Understanding how it works		2	
Making the kinematic scheme		2	
Calculation of transmission reports		2	
Calculation of torques and yields		2	
Making the PPT presentation		2	
Presentation and grading of the project		2	

Bibliography

Preda I. Transmisii mecanice avansate în ingineria automobilului. http://elearning.unitbv.ro

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

The content of the discipline was discussed with the professors of the department and with representatives of the company Shaeffler Romania.

10. Assessment

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight of the final grade
10.4 Course		Written knowledge testing	50%
10.5 Seminar/ laboratory/ project	Correctness of schemes and calculations.	Analysis of the presentation file.	30%
	The originality of the presentation.	Powerpoint presentation	20%
10.6 Minimum performance standard			
Grade 5 for the project Grade 5 on the knowledge test			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Dean, **Prof.dr.ing. Ioan Călin ROȘCA**	**Head of Department ,** **Prof.dr.ing. Mihai DUGULEANA**
Course holder, **Conf.dr.ing. Dragoș Sorin DIMA**	**Project coordinator** **Conf.dr.ing. Dragoș Sorin DIMA**

Note:

Field of study - choose one of the following variants: Bachelor's/Master's/Doctorate (to be filled in according to the Nomenclature of fields and specializations/university study programs in force);

The study cycle - one of the following variants is chosen: Bachelor's/ Master's/ Doctorate;

Discipline regime (content) - one of the variants is chosen**:** **DF** (fundamental discipline)/ **DD** (discipline in the field)/ **DS** (specialized discipline)/ **DC** (complementary discipline) - for the bachelor's level; **DAP** (deepening discipline)/ **DSI** (synthesis discipline)/ **DCA** (advanced knowledge discipline) - for the master's level;

Discipline regime (compulsory) - one of the variants is chosen: **DI** (compulsory subject)/ **DO** (optional subject)/ **DFac** (optional subject);

One credit is equivalent to 25 hours of study (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Fundamentals in Electronics and Computers					
2.2 Course convenor			Postelnicu Cristian-Cezar					
2.3 Seminar/ laboratory/ project convenor			Postelnicu Cristian-Cezar					
2.4 Study year	1	2.5 Semester	2	2.6 Evaluation type	V	2.7 Course status	Content[3)]	DAP
							Attendance type[4)]	DO

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**2**	out of which: 3.2 lecture	**1**	3.3 seminar/ laboratory/ project	**0/0/1**
3.4 Total number of hours in the curriculum	28	out of which: 3.5 lecture	14	3.6 seminar/ laboratory/ project	0/0/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	25
Additional documentation in libraries, specialized electronic platforms, and field research	15
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	14
Tutorial	4
Examinations	2
Other activities.....	2

3.7 Total number of hours of student activity	62
3.8 Total number per semester	90
3.9 Number of credits[5)]	3

4. Prerequisites (if applicable)

4.1 curriculum-related	• Graduation of Applied Electronics course
4.2 competences-related	• Knowledge and abilities to work in one or more standard or high-level programming languages (e.g., Excel, Matlab)

5. Conditions (if applicable)

5.1 for course development	• Lecture room with multimedia equipment and minimum 25 places
5.2 for seminar/ laboratory/ project development	• Lecture room with multimedia equipment, electronic components and materials, and minimum 25 places

6. Specific competences

Professional competences	**CP2. Skills in the design of systems, equipment and components of motor vehicles** L.O.2.1 the ability to study, interpret and capitalize on the technical resources specific to the automotive manufacturing industry; L.O.2.2 the use of advanced concepts, techniques and principles for the design of modern automotive systems and equipment; L.O.2.3 the application of mathematical methods and the use of calculation and simulation programs to perform technical analyses and design solutions for specific problems; L.O.2.5 Prototype design of automotive components and systems by applying advanced engineering principles; **CP4 Competences to carry out scientific research** L.O.4.1 To conduct scientific research, to conceive or create new knowledge by formulating questions in the field by researching, improving or developing concepts, theories, models, techniques, tools, software or operational methods and by using scientific methods and techniques; L.O.4.2 Gather information about current vehicle trends and styles and the need for new products or services; L.O.4.3 Prepare reports describing the results and processes of scientific or technical research or assessing its progress. These reports help researchers keep up with recent findings; L.O.4.4 Develop research papers or give presentations to report the results of a research project, indicating the analysis procedures and methods that led to those results, as well as possible interpretations of the results; L.O.4.5 Conduct research on present and future developments and trends in design, as well as related target market characteristics; L.O.4.6 Anticipate changes in automotive technology, supervise and investigate recent technological trends and developments; L.O.4.7 Manage research data; L.O.4.9 Synthesize information, interpret and critically summarize new and complex information from various sources; L.O.4.10 Interact professionally in research and professional environments; L.O.4.11 Apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results with a view to relevant estimation of the information, as well as related technical systems and their developments; L.O.4.12 Demonstrate in-depth knowledge and complex understanding of the field of research, including responsible research, ethical principles and scientific integrity in research, respect for privacy and GDPR requirements, related to research activities in a particular discipline. **CP.6 Competences for the use of CAD-CAM-CAE systems** L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimisation of an industrial design; **CP.7 Competences for the development of motor vehicle manufacturing and assembly technologies, test and validation procedures for motor vehicle components, systems and equipment** L.O.7.2 Evaluation of advanced technologies for the manufacture of motor vehicles and their correlation with the optimal operating parameters of motor vehicle systems; • L.O.7.3 applying and developing specific criteria, procedures and methods for the design of modern manufacturing, assembly and maintenance technologies for motor vehicles;

Transversal competences	**CT.1 Integration skills in specific activities at the workplace and technical skills, in conditions of autonomy and professional independence** L.O.1.1 to take responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O.1.2 to show determination, making sustained efforts for success by pursuing clear objectives, to make decisions by choosing from several alternative possibilities; L.O.1.3 show initiative, be proactive, L.O.1.4 to show self-reflection, quick thinking and to accept criticism and new guidance received from colleagues or superiors; L.O.1.5 provide advice to co-workers, providing suggestions on the best way forward; L.O.1.6 to be able to work in a team but also independently by developing their own ways of doing things, showing a willingness to learn, L.O.1.7 to analyse new problems that have arisen, based on creative, innovative, analytical, holistic thinking; L.O.1.8 to ensure customer orientation; R.Î.1.9 to apply scientific, technological and engineering knowledge, processing complex information; L.O.1.10 to identify problems and make decisions to solve them; L.O.1.11 to apply principles, policies and regulations aimed at environmental sustainability, including the reduction of waste, energy and water consumption, the reuse and recycling of products, as well as involvement in the collaborative economy; L.O.1.12 to comply with the rules, regulations and guidelines relating to a particular field or sector and to apply them in its day-to-day work; L.O.1.13 plan activities, manage the calendar and resources to complete tasks in a timely manner. **CT.2 Communication and teamwork skills** L.O.2.1 to carry out their work in a team; R.Î.2.2 to address an audience, to give a speech, to make a presentation; L.O.2.3 moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts; L.O.2.6 to be able to lead others, to coordinate a team; L.O.2.7 be able to train other team members and organize information, objects and resources; L.O.2.8 to motivate others, stimulating action; L.O.2.9 to develop teams, managing time and delegating responsibilities;

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Acquiring knowledge and forming basic skills in digital electronics and computer science.
7.2 Specific objectives	• Knowledge of the types of control systems in vehicles; • Understanding the role of control systems in vehicles and their operating principles; • Knowledge of the structure of the control systems and the functional role of the components; • Acquiring practical and practical skills in the field of measurements.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. Digital electronics basics	Presentation; Conversation (Use of teaching materials presented with video projector) Demonstration (use of representative real devices)	2	
2. Digital circuits components: (Numbering systems, Oscillators, Counters, Counter Decoding Circuitry, Shift Registers. Digital Displays. Encoders, Decoders etc.)		2	
3. Computer Architecture		2	
4. Computers memories (RAM, ROM, SRAM, DRAM, DMA)		2	
5. Busses. Data structures. Data processing		2	
6. Control unit. Microprocessors. Microcontrollers		2	
7. Input/Output Devices. Operating systems		2	
Bibliography 1. Ionel S. Inginerie Electronică, Editura Politehnica, Timisoara, 2011 2. Rajaraman, V., Fundamentals on Computers, Prentice Hall of India, 2006 3. Sedra A. S., Smith K.C., Microelectronic Circuits, Sounders College Publishing, New York, 1991 4. Jaeger R.C., Blalock T.N., Microelectronic Circuit Design, McGraw Hill, New York, 2004			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Implementation of a Raspberry Pi application in the field of Internet of things	Demonstration, experiment, direct action, problem-solving	14	
Bibliography 1. Ionel S. Inginerie Electronică, Editura Politehnica, Timisoara, 2011 2. Rajaraman, V., Fundamentals on Computers, Prentice Hall of India, 2006 3. Sedra A. S., Smith K.C., Microelectronic Circuits, Sounders College Publishing, New York, 1991 4. Jaeger R.C., Blalock T.N., Microelectronic Circuit Design, McGraw Hill, New York, 2004 5. Patterson, David A., and John L. Hennessy. Computer organization and design: the hardware/software interface. Morgan Kaufmann, 2008.			

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

The curriculum responds to the current requirements regarding the skills that automotive industry specialists must have.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Written	Written exam	
	- Knowledge of concepts; - The ability to apply the accumulated knowledge; - The language appropriate to the subject; - Attitude towards learning	The subjects cover the key chapters of the course.	70%
10.5 Seminar/	Project defend		

laboratory/ project	- Rhythm of activity; keeping the calendar;	- Direct and systematic observation; - Record progress - Project defend	30%
10.6 Minimal performance standard			
• The final average is calculated only if the student gets a minimum of 5 points at the project defend			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA Dean	Prof.dr.ing. Mihai Duguleana Head of departament
Postelnicu Cristian-Cezar Course holder	Postelnicu Cristian-Cezar Holder of laboratory

Note:

1) Field of study – select one of the following options: BA/MA/PhD. (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: BA/MA/PhD;

3) Course status (content) – for the BA level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the MA level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Automotive Design

2. Data about the course

2.1 Name of course			3D scanning and reconstruction techniques					
2.2 Course holder			Prof. Duguleană Mihai					
2.3 Seminar/ laboratory/ project convenor			Prof. Duguleană Mihai					
2.4 Study year	1	2.5 Semester	1	2.6 Evaluation type	V	2.7 Discipline status	Content[2)]	SC
							Attendance type[3)]	NCPC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 course	**2**	3.3 seminar/ laboratory/ project	**0/2/0**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 course	28	3.6 seminar/ laboratory/ project	0/28/0

Time allocation	hours
Study of textbooks, course support, bibliography and notes	20
Additional documentation in libraries, specialized electronic platforms, and field research	26
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	14
Tutorial	2
Examinations	2
Other activities.....	

3.7 Total number of individual learning hours	64
3.8 Total number per semester	120
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 to the curriculum	Knowledge of 3D Modelling, 3D Graphics Programming
4.2 to competences	Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 of course development	• Classroom equipped with multimedia equipment and minimum capacity of 25 seats
5.2 of seminar/ laboratory/ project development	• Laboratory room, with board, equipped with specific systems, minimum 13 seats.

6. Specific competences

Professional competences	Cp1. Competences in the design of systems, equipment and vehicle components L.O.1.1 the ability to study, interpret and capitalize on technical resources specific to the motor vehicle manufacturing industry; L.O.1.2 the use of advanced concepts, techniques and principles regarding the design of modern systems and equipment intended for motor vehicles; L.O.1.3 applying mathematical methods and using calculation and simulation programs to perform technical analyzes and design solutions for specific problems; L.O.1.4 designing prototypes of vehicle components and systems by applying advanced engineering principles; Cp3. Skills in using CAD-CAM-CAE systems L.O.3.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model;
Transversal competences	Ct1. Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts; L.O.2.6 to be able to lead others, coordinate a team; L.O.2.7 be able to train other team members and organize information, objects and resources; L.O.2.8 to motivate others, stimulating action; L.O.2.9 to develop teams, managing time and delegating responsibilities; L.O.2.10 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General discipline objective	Theoretical and practical training in 3D scanning and reconstruction fundamentals.
7.2 Specific objectives	◘ Understanding different 3D scanning methods ◘ Deepening the photogrammetry technique

8. Content

8.1 Course	Teaching methods	Hours	Remarks

1. Introduction to 3D scanning techniques - Mathematical explanation; - The specificity of the scanning technologies; - Functions of the resulting 3D models; - Requirements and performance of the systems used.	Exposure; Conversation (Use of teaching materials provided with the projector)	4 hours	
2. Fundamentals of 3D modeling: - modeling programs - software editing - digital representations - formats and working environments		4 hours	
3. Reconstruction technologies: - data collection systems - processing systems - display systems		4 hours	
4. 3D scanning methods - laser scanning; - photogrammetry.		4 hours	
5. Photogrammetry - Shooting procedure; - Pre-processing; - Processing software - Post-processing		4 hours	
6. Photogrammetry with drones: - particularities - specialized software - GIS		4 hours	
7. Laser scanning: - Scanning procedure; - Pre-processing; - Processing software - Post-processing		4 hours	
Bibliography 1. Mikhail, Edward M., James S. Bethel, and J. Chris McGlone. "Introduction to modern photogramme York (2001). 2. Eisenbeiß, Henri. UAV photogrammetry. Diss. ETH Zurich, 2009. 3. Baltsavias, Emmanuel P. "A comparison between photogrammetry and laser scanning." ISPRS J photogrammetry and Remote Sensing 54.2-3 (1999): 83-94.			
8.2 Seminar/ laboratory/ project	Teaching-learning met		Remarks
8.2.1 Laboratory			
1. Laboratory equipment. Use of cameras for photogrammetry	Demonstration experiment, direct action, problems.	4 hours	
2. Data acquisition and processing		8 hours	
3. Laser scanning vs photogrammetry - comparison		4 hours	
4. Photogrammetry with UAV		8 hours	
5. Study on web collections		4 hours	

Bibliography

1. Mikhail, Edward M., James S. Bethel, and J. Chris McGlone. "Introduction to modern photogrammetry." New Yor
2. Eisenbeiß, Henri. UAV photogrammetry. Diss. ETH Zurich, 2009.
3. Baltsavias, Emmanuel P. "A comparison between photogrammetry and laser scanning." ISPRS Jo photogrammetry and Remote Sensing 54.2-3 (1999): 83-94.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	An ability to apply knowledge of mathematics, science, and engineering. An ability to identify, formulates, and solves engineering problems.	Theoretical and practical examination – project, case study	50%
10.5 Seminar/ laboratory/ project	An ability to design a system, component or process to meet desired needs.	Laboratory	15%
	An ability to use techniques, skills, and modern engineering tools necessary for engineering practices; project - case study	Applications test, exercises	35%
• Participation in the exam is conditional on the complete laboratory work and the promotion of the laboratory colloquium.			
10.6 Minimal performance standard			
• Minimum requirements for grade 5: at all assessment activities, a minimum of half of the score awarded, respectively minimum grade 5. The minimum performance standards are given by: o Use of specific equipment for 3D reconstruction / scanning. o Use of software for 3D reconstruction / scanning. o Making 3D models using web information.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA Dean of Faculty of Mechanical Engineering	Prof.dr.ing. Duguleană Mihai Head of Departament Automotive and Transportation Engineering
Prof. Duguleană Mihai Course holder	Prof. Duguleană Mihai Holder of seminar/ laboratory

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotives and Transportation
1.4 Field of study[1)]	Master
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotives Design

2. Data about the course

2.1 Name of course			Experimental Systems for testing the Automotives Elements					
2.2 Course convenor			Prof.dr.ing. Lates Mihai Tiberiu					
2.3 Seminar/ laboratory/ project convenor			Prof.dr.ing. Lates Mihai Tiberiu					
2.4 Study year	2	2.5 Semester	3	2.6 Evaluation type	V	2.7 Course status	Content[3)]	AC
							Attendance type[4)]	CPC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**2**	out of which: 3.2 lecture	**1**	3.3 seminar/ laboratory/ project	**1**
3.4 Total number of hours in the curriculum	28	out of which: 3.5 lecture	14	3.6 seminar/ laboratory/ project	14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	39
Additional documentation in libraries, specialized electronic platforms, and field research	19
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	14
Tutorial	-
Examinations	3
Other activities.....	-

3.7 Total number of hours of student activity	72
3.8 Total number per semester	100
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Tribology, Advanced Mechanical Transmissions in Automotives Engineerings.
4.2 competences-related	• Theoretical and practical knowledge in the field of tribological and automotives mechanical transmissions testing.

5. Conditions (if applicable)

5.1 for course development	• Classroom with blackboard and video projector • Recommended references
5.2 for seminar/ laboratory/ project development	• Laboratory with test rig • Recommended references

6. Specific competences and learning outcomes

CP.1 Adjusting the products projects

Learning outcomes.

1.1. Knowledge

R.Î.1.1.1 The graduate of the master's study program is able to interpret the technical requirements of the clients, analyzing, understanding and applying the information provided regarding the technical conditions;

R.Î.1.1.3 The graduate of the master's study program is able to identify customer needs, using appropriate questions and active listening to identify customer expectations, wishes and requirements according to products and services;

1.2 Abilities

R.Î.1.2.4 preparation of functional models, prototypes for testing the concepts and reproduction possibilities; creating the prototypes to evaluate the pre-production tests;

R.Î.1.2.5 elaboration of the test protocols for the automotives components and equipments;

1.3 Responsibility and autonomy

R.Î.1.3.2 Approving the technical project of the final product in order to machining and assembling the product.

CP.3 Anticipates the automotives technologies changes

Learning outcomes.

3.1. Knowledge

R.Î.3.1.1. The graduate analyses and argues the theoretical and experimental results and the technical documentation associated to the automotive engineering domain.

3.2. Skills

R.Î.3.2.1. The graduate proves knowing and using of the advanced analysis methods in the automotives construction and exploitation.

3.3. Responsibility and autonomy

R.Î.3.3.1. The graduate proves autonomy in learning specific problems to the domain.

CP.8 Makes the scientific research

Learning outcomes.

8.1 Knowledge

R.Î.8.1.1 The graduate proves the thorough knowledge and complex understanding of the research domain, including the responsible research, the ethics and sci9entific integrity in the research process, the private life respect and the GDPR demands regarding the research process in a given area.

R.Î.8.1.2 The graduate makes scientific research, designs and creates new knowledge by formulating questions in the domain through research, optimization and development of concepts, theories, models, techniques, tools, software or operational methods by using scientific methods and techniques.

R.Î.8.1.3 The graduate is capable to collect information about the actual styles and tendencies regarding the vehicles and the new products and services requirements.

R.Î.8.1.4 the graduate is capable to make researches regarding the present and future evolutions and the design trends and regarding the targeted characteristics connected to the market.

R.Î.8.1.5 The graduate is capable to prepare reports which describe the results from scientific or technical research or evaluate their progresses. These reports help the researchers to be informed with the recent discoveries.

R.Î.8.1.6 The graduate is capable to synthesize information, to interpret and to resume critically new and complex from different sources.

R.Î.8.1.7 The graduate is capable to anticipate the automotives technologies changes, tu supervise and to investigate the actual tendences and technological evolutions.

8.2 Abilităţi

R.Î.8.2.1 Absolventul este capabil să opereze aparate de cercetare stiintifica si de laborator;

R.Î.8.2.2 Absolventul este capabil să aplice metode de cercetare sistematica si să comunice cu

Transversal competences	**CT.1 Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence** Learning outcomes. The graduate of the master's study program is able to: R.Î.1.1 to take responsibility, to accept responsibility for one's own decisions, showing willingness to work, respecting one's commitments; R.Î.1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; R.Î.1.3 to show initiative, to be proactive. **CT.2 Communication and teamwork skills** Learning outcomes. The graduate of the master's study program is able to: R.Î.2.1 to carry out their work in a team; R.Î.2.2 to address an audience, give a speech, make a presentation; R.Î.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Theoretical and applied training in experimental tests and associated mechanical and mechatronic systems.
7.2 Specific objectives	• Theoretical and applied training on the structure, programming and operation of test stands. • Training in the development of experiments.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. Test planning. The parameters. Control. Values. Precision. Equipment. Saving data.	Lecture based on video projector	1 hour	
2. Analysis of experimental data. Errors. Uncertainty analysis. Statistical analysis. Graphic formats.	Lecture based on video projector	1hour	
3. Measurement of forces. Forces. Moments. Tensions and efforts.	Lecture based on video projector	2 hours	
4. Measurement of displacements. Travels. Speeds. Vibrations.	Lecture based on video projector	2 hours	
5. Definition of tests. Testing of mechanical transmissions (gears, chain drives, belt drives). Bearing testing. Tribological testing.	Lecture based on video projector	7 hours	
6. Acquisition of data. Drafting the report and presentation.	Lecture based on video projector	1 hour	
Bibliography 1. J. P. Holman. Experimental methods for engineers. Boston, McGraw-Hill Publishing House, 2001.			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks

1. Run-in tests	Practical tests	2 hours	
2. Chain/skid friction testing	Practical tests	2 hours	
3. Testing chain drives	Practical tests	2 hours	
4. Bearing testing	Practical tests	2 hours	
5. Testing of bearing assemblies	Practical tests	2 hours	
6. Chain/skid wear testing (oscillating motion)	Practical tests	2 hours	
7. Chain/skid Stribeck curve testing	Practical tests	2 hours	

Bibliography

1. J. P. Holman. Experimental methods for engineers. Boston, McGraw-Hill Publishing House, 2001.

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Theoretical knowledge underpins the latest approaches in the field of experimental systems in automotive mechanics, and practical examples are based on mechanical engineering problems.

The analytical program is in line with the new requirements of the companies producing automotive components (eg Schaeffler Group).

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Correct use of specific testing principles and selection of appropriate test solutions for given problems	Written exam	50%
10.5 Seminar/ laboratory/ project	Correct use of test stands for given problems	Oral exam	50%
10.6 Minimal performance standard			
Correct use of testing principles for given problems			

Evaluation grille with performance levels

Performance level	General description	Characteristics
Excellent (10–9)	Knows all the concepts. The analyses are innovative and clear	Perfect terminology, logic structure, autonomy, critical thinking
Verry good (8)	Proves very good understanding and correct applying.	Minor errors, conceptual and applicative coherence
Good (7)	Knows the basic concepts, but the applications are partially accomplished	Sometimes no exact terminology, incomplete explanations
Sufficient (5-6)	Non-logic application of the knowledge.	Partially correct answers, lacunas of logic
Nonsufficient (<5)	Not proving the understanding of the basic concepts	Theoretic confusions, wrong applications, lack of argumentations

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof. dr. eng. Ioan Călin ROSCA **Dean**	**Prof. dr. eng. Mihai DUGULEANA** **Head of Department**
Prof.dr.ing. Mihai Tiberiu LATES **Course holder**	**Prof.dr.ing. Mihai Tiberiu LATES** **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

[2)] Study level – choose from among: Bachelor / Master / Doctorat;

[3)] Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4)] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5)] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Faculty of Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Virtual Instrumentation					
2.2 Course convenor			Prof. Dr Petru A. COTFAS					
2.3 Seminar/ laboratory/ project convenor			Prof. Dr Petru A. COTFAS					
2.4 Study year	II	2.5 Semester	1	2.6 Evaluation type	E	2.7 Course status	Content[3)]	SC
							Attendance type[4)]	CPC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**2**	out of which: 3.2 lecture	**1**	3.3 seminar/ laboratory/ project	**0/1/0**
3.4 Total number of hours in the curriculum	28	out of which: 3.5 lecture	14	3.6 seminar/ laboratory/ project	0/14/0

Time allocation	hours
Study of textbooks, course support, bibliography and notes	42
Additional documentation in libraries, specialized electronic platforms, and field research	34
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	28
Tutorial	14
Examinations	4
Other activities.....	

3.7 Total number of hours of student activity	122
3.8 Total number per semester	150
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• Basic knowledge of computer programming
4.2 competences-related	• Using of computers

5. Conditions (if applicable)

5.1 for course development	• Classroom with multimedia systems.
5.2 for seminar/ laboratory/ project development	• Classroom with necessary systems and PCs.

6. Specific competences and learning outcomes

Professional competences	CP.1 Adjusts product designs 1.1 Knowledge L.O.1.1.4 The graduate can study, interpret and capitalise on technical resources specific to the automotive manufacturing industry; 1.2 Skills L.O.1.2.2 The graduate can apply mathematical methods and the use of calculation and simulation programs to perform technical analyses and design solutions for specific problems; CP.4 Approves engineering projects 4.1. Knowledge L.O.4.1.1. The graduate analyses and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. 4.2. Skills L.O.4.2.2. The graduate evaluates and approves technological projects for the manufacture and assembly of automobiles or their components; CP.8 Conducts scientific research. 8.1 Knowledge L.O.8.1.2 The graduate conducts scientific research, conceives and creates new knowledge by formulating questions in the field by researching, improving or developing concepts, theories, models, techniques, instruments, software or operational methods and by using scientific methods and techniques; L.O.8.1.6 The graduate is able to synthesize information, critically interpret and summarize new and complex information from various sources. CP.13 Develops test procedures 13.1 Knowledge L.O.13.1.1 To interpret and analyze data collected during testing, to formulate conclusions, new perspectives or solutions. L.O.13.1.2 To record data that have been specifically identified during previous trials, to verify that the results of the trial produce specific results; 13.2 Skills L.O.13.2.1 The graduate has the ability to operate precision measurement equipment; L.O.13.2.2 The graduate has the ability to evaluate the performance of automotive systems by using specific testing procedures and equipment; L.O.13.2.8 The graduate has the ability to select, acquire and use automotive testing equipment; CP.15 Uses application-specific interfaces. 15.1 Knowledge L.O.15.1.1 The graduate can evaluate and choose platforms, programming languages and software technologies suitable for projects in the automotive industry; 5.2 Skills L.O.15.2.1 The graduate has the ability to understand and apply the principles of programming and software development technologies in the automotive industry; L.O.15.2.2 The graduate has the ability to develop software for automotive and related systems; L.O.15.2.4 The graduate has the ability to test and debug software to ensure the correct and safe operation of automotive systems; 15.3 Responsibility and autonomy L.O.15.3.1 The graduate has the ability to manage automotive software development projects, including planning, budgeting and monitoring progress.

	CP.16 Design the user interface 16.1 Knowledge L.O.16.1.2 The graduate has in-depth knowledge of software architectures for graphical interfaces and an understanding of how they contribute to modular and maintainable development. L.O.16.1.3 The graduate has in-depth knowledge of specific programming techniques and languages. 16.2 Skills L.O.16.2.2 The graduate can design information architecture, user flows, wireframes and prototypes of intuitive and efficient interfaces L.O.16.2.3 The graduate can integrate software components with hardware specific to systems or machines (e.g. sensors, actuators, displays, buttons), using appropriate drivers and APIs. 16.3 Responsibility and autonomy L.O.16.3.3 The graduate can adapt quickly to new requirements, technologies or changes in project specifications. L.O.16.3.4 The graduate demonstrates initiative in exploring and implementing innovative solutions to improve human-system/machine interaction.
Transversal competences	CT.1 Self-management skills and competences L.O.1.3 to show initiative, to be proactive; CT.2 Social and communication skills and competences L.O.2.1 to work in a team; L.O.2.2 to address an audience, to give a speech, to make a presentation;

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Explaining the concepts related to the virtual instrumentation from the perspective of using them in designing and managing the electric, electronic and mechatronic systems of automobiles.
7.2 Specific objectives	• Understanding the specific concepts of virtual instrumentation and using graphical programming architectures in solving specific engineering problems; • Gaining practical skills of working with software packages for virtual instrumentation dedicated to the management and control of the mechatronic systems in auto-vehicles. • Gaining the theoretic and applied knowledge about the structure and testing for electric, electronic and mechatronic systems of automobiles.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Introduction of the Virtual Instrumentation and Graphical System Design concepts. Graphical Programming Language - LabVIEW	Lecture with cu slides improved by conversation, didactic demonstration. Learning through demonstrations by simulation and hardware using.	2 hours	
Modular Programming. Programming Structures.		2 hours	
Advanced Programming Architectures		2 hours	
Data acquisition in LabVIEW. Measurements and data logging in auto-vehicles		4 hours	
Drivers and communication interfaces with mechatronic systems in auto-vehicles.		2 hours	
Virtual Instrumentation applications. Combining the LabVIEW software with CAD software.		2 hours	

Bibliography

1. P.A. Cotfas, Instrumentație Virtuală, notițe de curs, 2024-2025;
2. P. Adrian Cotfas, D. Tudor Cotfas, and H. Hedesiu, Eds., "LabVIEW - Virtual Instrumentation in Education and Industry", IntechOpen, Jun. 12, 2024. doi: 10.5772/intechopen.102279.
3. H.A. Modran, D. Ursutiu, Instrumentatie virtuala : indrumar de laborator [Resursa electronica], Editura Universitatii Transilvania din Brasov, 2022;
4. J. Essick Hands-On Introduction to LabVIEW for Scientists and Engineers, Oxford University Press Inc, 2018;
5. P. A. Cotfas, D. T. Cotfas, D. Ursutiu, C. Samoila "NI ELVIS Computer-Based Instrumentation", National Technology & Science Press – USA, ISBN 978-1-934891-11-7, IDS Number: 745SR, ISSN: 1582-2214, 2011;
6. P.A. Cotfas "Prelucrarea semnalelor. Aplicatii in LabVIEW", Ed. Lux Libris, ISBN 978-973-131-071-8, Brasov, 2010;
7. ***LabVIEW Manual (LabVIEW Help);
8. Ghionea, I., Initiere in mediul de programare grafica LabVIEW, www.catia.ro/articole.html , Accesat octombrie 2011;

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Laboratory introduction. LabVIEW introduction	Conversation	Duration: 2 hours	
Applications based on programming structures	Conversation + individual experiment	Duration: 2 hours	
State-Machine and Producer-Consumer architectures in automotive applications	Conversation + individual experiment	Duration: 2 hours	
Virtual Instruments for monitoring and control using sensors and actuators	Conversation + individual experiment	Duration: 4 hours	
Electric and electronic instruments control based on LabVIEW drivers	Conversation + individual experiment	Duration: 2 hours	
Working with LabVIEW projects. Testing the mechatronic systems in auto-vehicles.	Conversation + individual experiment	Duration: 2 hours	

Bibliography

1. P.A. Cotfas, Instrumentație Virtuală, notițe de curs, 2024-2025;
2. P. Adrian Cotfas, D. Tudor Cotfas, and H. Hedesiu, Eds., "LabVIEW - Virtual Instrumentation in Education and Industry", IntechOpen, Jun. 12, 2024. doi: 10.5772/intechopen.102279.
3. H.A. Modran, D. Ursutiu, Instrumentatie virtuala : indrumar de laborator [Resursa electronica], Editura Universitatii Transilvania din Brasov, 2022;
4. J. Essick Hands-On Introduction to LabVIEW for Scientists and Engineers, Oxford University Press Inc, 2018;
5. P. A. Cotfas, D. T. Cotfas, D. Ursutiu, C. Samoila "NI ELVIS Computer-Based Instrumentation", National Technology & Science Press – USA, ISBN 978-1-934891-11-7, IDS Number: 745SR, ISSN: 1582-2214, 2011;
6. P.A. Cotfas "Prelucrarea semnalelor. Aplicatii in LabVIEW", Ed. Lux Libris, ISBN 978-973-131-071-8, Brasov, 2010;
7. ***LabVIEW Manual (LabVIEW Help);
8. Ghionea, I., Initiere in mediul de programare grafica LabVIEW, www.catia.ro/articole.html , Accesat octombrie 2011;

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

The content of the course assures acquiring knowledge and the necessary skills in the use of modern technologies in the field of virtual instrumentation and the ability to use programming techniques using the LabVIEW graphic programming language with applications in the automotive field.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Correct explanation of creating a virtual instrument, implementing an architecture or method using the theoretic knowledge taught.	Written evaluation on subjective or objective items Written evaluation on subjective or objective items	70%
	Comparative analysis of certain architectures or programming methods.		
	Correct usage of specific language		
	Clarity, coherence and concision in presentation		
	Coverage of requested topics		
	Correct explanation of creating a virtual instrument, implementing an architecture or method using the theoretic knowledge taught.		
10.5 Seminar/ laboratory/ project	Implementation of architecture or programing method for creating a virtual instrument for information acquisition or processing.	Computer testing and also checking the completion of works during laboratory.	30%
10.6 Minimal performance standard			
• Theoretic trial: getting a minimum score of 4 points from the 9 allocated to the theoretical subjects; a point by default. • Laboratory: Using modular programing in LabVIEW and accomplishing data acquisition and graphic display of results in the application panel.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof. Dr. Ing. Ioan Călin Roșca, **Dean of Faculty of Mechanical Engineering**	**Prof. univ. dr. ing. DUGULEANĂ Mihai** **Head of Department**
Prof. Dr. Petru A. COTFAS, **Course holder**	**Prof. Dr. Petru A. COTFAS,** **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

[2] Study level – choose from among: Bachelor / Master / Doctorat;

[3] Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Practice for research and development I					
2.2 Course convenor								
2.3 Seminar/ laboratory/ project convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	2	2.5 Semester	3	2.6 Evaluation type	C	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	**NCPC**

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**12**	out of which: 3.2 lecture	**0**	3.3 seminar/ laboratory/ project	**0/0/12**
3.4 Total number of hours in the curriculum	168	out of which: 3.5 lecture	0	3.6 seminar/ laboratory/ project	168

Time allocation	hours
Study of textbooks, course support, bibliography and notes	
Additional documentation in libraries, specialized electronic platforms, and field research	
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	
Tutorial	
Examinations	
Other activities.....	

3.7 Total number of hours of student activity	168
3.8 Total number per semester	168
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Elementary concepts of automotive engineering, computer-aided design
4.2 competences-related	• Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 for course development	• projector
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • Windows operating system, Matlab

6. Specific competences and learning outcomes

Professional competences	C1. Automobile Construction L.O.1.1 The graduate identifies and explains the basic concepts, theories and methods of the field of automotive engineering and the specialization. L.O.1.2 The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. L.O.1.3 The graduate develops professional projects by selecting, combining, and using concepts, principles, methodologies and technologies from the field. L.O.1.4 The graduate selects and analyzes bibliographic sources specific to the field. L.O.1.5 The graduate demonstrates autonomy in learning on issues specific to the field. C2. Conducts scientific research. L.O.2.1 The graduate is able to gather information on current vehicle trends and styles and the need for new products or services. L.O.2.2 The graduate is able to conduct research on current and future developments and design trends, as well as related target market characteristics. L.O.2.3 The graduate is able to prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep abreast of recent discoveries. L.O.2.4 The graduate is able to synthesize information, critically interpret and summarize new and complex information from various sources. L.O.2.5 The graduate is able to anticipate changes in automotive technology, monitor and investigate recent technological trends and developments. L.O.2.6 The graduate is able to apply systematic research methods and communicate with relevant parties to find specific information, evaluating research results in terms of relevant estimation of information, as well as related technical systems and their developments. L.O.2.7 The graduate is able to anticipate changes in automotive technology, to monitor and investigate recent technological trends and developments. L.O.2.8 The graduate is able to prepare research documents or give presentations to report the results of a research project carried out, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results. L.O.2.9 The graduate is able to manage data in the field of research.

Transversal competences	Ct1. Self-driving skills and competencies L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Social and communication skills and competencies L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.4 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Apply scientific knowledge to solve automotive engineering problems.
7.2 Specific objectives	• Practical skills for simulating the development processes of automotive products. • Practical skills for working with integrated software packages for controlling mechatronic systems of vehicles • Practical skills of advanced simulation in the design of vehicles • Development of modern software, innovative methods, principles and simulation procedures • Development of methods for evaluating research and development projects • Developing a management strategy using modern principles and methods

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Not the case			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Clutch model in Simulink	Presentations, examples, experiments, research on the dynamic simulation of the vehicle systems, virtual collision modeling and testing, the sensory and control systems of the vehicles, virtual instrumentation	168	
The suspension system in Simulink			
Servo electro-hydraulic control in Simulink			
Development of a C ++ application for dynamic simulation of a vehicle			
Group projects			

Bibliography

1. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.

2. https://www.mathworks.com/examples/simulink/category/automotive-applications
3. https://www.computoolable.nl

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Through its content and through the elaboration of the thematic portfolio (the study), the masters acquire competences in accordance with the expectations of the epistemic community and of the producers in the car market. The analytical program is in line with similar fields addressed at universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course			
10.5 Seminar/ laboratory/ project	Completion of simulations in Simulink	Oral presentation	100%
	Development of the C ++ program		
	Involvement in practical activities		
	Efficiency in verbal communication (presentation)		
	Completion of simulations in Simulink		
10.6 Minimal performance standard			
• Knowledge of Simulink and C++ fundamentals • Realization of a Simulink simulation for engineering applications • Realization of practical project • The marks for project work must be at least 5.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** **Head of Department**
Prof. Ph. D. eng. Florin GÎRBACIA, **Course holder**	Prof. Ph. D. eng. Florin GÎRBACIA, **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

[2] Study level – choose from among: Bachelor / Master / Doctorat;

[3] Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Dynamic simulation of vehicle systems in Matlab and C ++					
2.2 Course convenor			Assoc. Prof. Ph. D. Olivia Florea Prof. Ph. D. eng. Florin GÎRBACIA					
2.3 Seminar/ laboratory/ project convenor			Assoc. Prof. Ph. D. Olivia Florea Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	2	2.5 Semester	3	2.6 Evaluation type	E	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	EC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/0/2**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/0/28

Time allocation	hours
Study of textbooks, course support, bibliography and notes	9
Additional documentation in libraries, specialized electronic platforms, and field research	14
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	7
Tutorial	6
Examinations	4
Other activities.....	4

3.7 Total number of hours of student activity	44
3.8 Total number per semester	100
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Knowledge of the vehicle dynamics
4.2 competences-related	• Operating with fundamental concepts of engineering sciences. • MATLAB Fundamentals

5. Conditions (if applicable)

5.1 for course development	• projector • lecture notes • recommended bibliography
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • lecture notes • recommended bibliography

6. Specific competences and learning outcomes

Professional competences	Cp1. Design and execute the virtual model of a product L.O.1.1 The graduate has the ability to build complex mathematical models, to translate technical specifications and performance requirements into equations and algorithms that describe the behavior of an automotive system or component. L.O. 1.2 The graduate has the ability to prepare models for simulation: and to perform numerical simulations, to interpret the results. L.O.1.3 The ability to run various types of simulations (structural, thermal, fluidic, etc.) and to critically analyze the results obtained, identifying potential problems or optimization opportunities. L.O.1.4 The graduate has the ability to optimize the product design based on the simulation results to improve the performance, reliability or efficiency of an automotive component or system. L.O.1.5 The graduate has the ability to effectively communicate the results of modeling and simulation. L.O.1.6 The graduate has the ability to integrate various software tools and manage data transfer between them. L.O.1.7 The graduate will demonstrate autonomy in choosing appropriate modeling tools and methods. L.O.1.8 The graduate will demonstrate responsibility for the accuracy and validity of the created models, recognizing the limitations of numerical models and the importance of their validation through experimental data or other methods. L.O.1.9 The graduate will demonstrate a proactive attitude in solving problems, by identifying and addressing technical challenges related to modeling and simulation, seeking innovative and efficient solutions. Cp2. Design and execute the virtual model of a product L.O.2.1 The graduate will demonstrate in-depth knowledge of the fundamental principles of computational geometry and the mathematical representation of three-dimensional shapes, the differences and applications of wireframe, surface and solid models, as well as the concepts of parametric and direct modeling. L.O.2.2 The graduate has the ability to fluently use CAE/CAD software to create 3D models: This includes modeling complex parts, assemblies, generating technical drawings and applying geometric constraints and relationships. L.O.2.3 The graduate has the ability to optimize product design based on simulation results to improve the performance, reliability or efficiency of an automotive component or system. L.O.2.4 The graduate has the ability to integrate various software tools and manage data transfer between them. L.O.2.5 The graduate will demonstrate autonomy in choosing appropriate modeling tools and methods. L.O.2.6 The graduate will demonstrate a proactive attitude in solving problems, by identifying and addressing technical challenges related to modeling and simulation, seeking innovative and effective solutions. Cp3. Uses application-specific interfaces L.O.3.1 The graduate can evaluate and choose platforms, programming languages, and software technologies suitable for automotive industry projects. L.O.3.2 The graduate has the ability to understand and apply the principles of programming and software development technologies in the automotive industry. L.O.3.3 The graduate has the ability to manage automotive software development projects, including planning, budgeting, and monitoring progress.

Transversal competences	Ct1. Self-driving skills and competencies L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Social and communication skills and competencies L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.4 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Understanding the principles and potential for using advanced Matlab and C++ Integrated Development Environments for automotive design. • Understand and gain advanced knowledge required to develop applications for dynamic simulation of vehicle systems based on Matlab and C++. • Understanding how to apply basic modeling techniques and tools to develop Simulink block diagrams
7.2 Specific objectives	• Learning of knowledge for creating dynamic simulation of vehicle systems required in automotive design; • Learning knowledge for the development of Matlab and C++ software applications; • Acquirement of practical skills for automotive design applications through the use of Matlab and C++ programming environments. • Creating Simulink models and simulating system dynamics • Modeling continuous-time, discrete-time, and hybrid systems • Building hierarchy into a Simulink model

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Introduction. The purpose of the course. Introduction to C++. Terminology, definitions and features of C++. Technologies available for dynamic simulation of vehicle systems.	Interactive lecture	2	
Basics of the C++ language. Getting Started with Microsoft Visual Studio IDE. Variables, data types, expressions, operators, pointers, networks, functions and structures in C++. Case studies for dynamic simulation.	Interactive lecture	8	
Vehicle dynamics problems solved in C++. Concepts	Interactive lecture	4	

and principles in object-oriented programming: Classes, objects, class hierarchies, Polymorphism. Case studies for dynamic simulation.			
Introduction to Simulink	Interactive lecture	4	
Simulink: Creating and Simulating a Model. Modeling Programming Constructs. Modeling Discrete Systems. Modeling Continuous Systems	Interactive lecture	6	
Simulink: Solver Selection. Developing Model Hierarchy. Modeling Conditionally Executed Algorithms. Combining Models into Diagrams	Interactive lecture	4	

Bibliography

1. Ruxandra Stanescu, Florin Girbacia, Cristian Postelnicu, Programarea calculatoarelor si limbaje de programare. Indrumar de laborator.,Ed. Universitatii Transilvania din Brasov, ISBN 978-606-19-1596-5, 2023.
2. Talabă, D., Amditis, A. Product Engineering, Tools and Methods Based on Virtual Reality. Editura Springer, 2007.
3. Gîrbacia, F. Talabă, D., Tehnologiile realității virtuale:lucrări practice, Editura Universită ii Transilvania Braşov, 2012.
4. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
5. Girbacia, F. Cercetari teoretice si experimentale privind dezvoltarea de interfete multimodale de realitate virtuala pentru aplicatii de proiectare asistata de calculator,Teza de doctorat,Universitatea Transilvania Brasov, 2007.
6. H. Schildt: C++. Editura Manual complet, Teora, 2000
7. Learning Simulink, COPYRIGHT 1999 - 2004 by The MathWorks, Inc.
8. Introduction to Simulink, University College of Southeast Norway, http://home.hit.no/~hansha/documents/matlab/training/Introduction%20to%20Simulink/ Introduction%20to%20Simulink.pdf

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Getting Started with Microsoft Visual Studio C++ IDE	Interactive lecture, exercises and examples, individual work	2	
Development of a C++ application for simulating a vehicle mechanism using procedural programming	Interactive lecture, exercises and examples, individual work	4	
Development of a C++ application for the simulation of a vehicle mechanism using modular programming	Interactive lecture, exercises and examples, individual work	4	
Development of a C++ application for dynamic simulation of a vehicle using OOP	Interactive lecture, exercises and examples, individual work	4	
Engine Model in Simulink	Individual work	2	
Anti-Lock Braking System in Simulink	Individual work	2	
Clutch Engagement Model in Simulink	Individual work	2	
Suspension System in Simulink	Individual work	2	
Hydraulic Systems in Simulink	Individual work	2	
Automatic Transmission Control in Simulink	Individual work	2	
Electrohydraulic Servo Control in Simulink	Individual work	2	

Bibliography

1. Ruxandra Stanescu, Florin Girbacia, Cristian Postelnicu, Programarea calculatoarelor si limbaje de programare. Indrumar de laborator,Ed. Universitatii Transilvania din Brasov, ISBN 978-606-19-1596-5, 2023.
2. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
3. https://www.mathworks.com/examples/simulink/category/automotive-applications

https://www.computoolable.nl

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Theoretical and practical approaches demonstrate the latest programming IDE for automotive design. The curriculum is consistent with similar fields addressed to universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Ability to operate with assimilated knowledge	Written exam	50%
10.5 Seminar/ laboratory/ project	Ability to apply in practice the assimilated knowledge	Project	50%
10.6 Minimal performance standard			
Development of a project that uses principles and methods specific to the field of mechanical engineering: • Knowledge of the fundamental elements of Matlab and C++, solving dynamic simulation task. • Implement a dynamic vehicle system model in Simulink. • The grades obtained for the project and exam must be at least 5			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, ... **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** ..... **Head of Department**
Assoc. Prof. Ph. D. Olivia Florea, ... Prof. Ph. D. eng. Florin GÎRBACIA, ... **Course holder**	Assoc. Prof. Ph. D. Olivia Florea, ... Prof. Ph. D. eng. Florin GÎRBACIA, ... **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

[2] Study level – choose from among: Bachelor / Master / Doctorat;

[3] Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Automotive energy management					
2.2 Course convenor			Postelnicu Cristian-Cezar					
2.3 Seminar/ laboratory/ project convenor			Postelnicu Cristian-Cezar					
2.4 Study year	2	2.5 Semester	1	2.6 Evaluation type	V	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	EC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	4	out of which: 3.2 lecture	2	3.3 seminar/ laboratory/ project	0/0/2
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/0/28

Time allocation	hours
Study of textbooks, course support, bibliography and notes	20
Additional documentation in libraries, specialized electronic platforms, and field research	16
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	2
Tutorial	2
Examinations	2
Other activities.....	2

3.7 Total number of hours of student activity	44
3.8 Total number per semester	100
3.9 Number of credits[5)]	4

4. Prerequisites (if applicable)

4.1 curriculum-related	• Graduation of Applied Electronics course
4.2 competences-related	• Knowledge and abilities to work in one or more standard or high-level programming languages (e.g., Excel, Matlab)

5. Conditions (if applicable)

5.1 for course development	• Lecture room with multimedia equipment and minimum 25 places
5.2 for seminar/ laboratory/ project development	• Lecture room with multimedia equipment, electronic components and materials, and minimum 25 places

6. Specific competences

Professional competences	Cp1. Competencies for performing practical tests and determinations L.O.1.1 To perform experimental, environmental, and operational tests on models, prototypes or systems and equipment to test their resistance and capabilities in normal and extreme conditions; L.O. 1.2 Interpret and analyze data collected during testing to formulate conclusions, new insights, or solutions. L.O.1.3 To record data that has been specifically identified during previous trials, to verify that trial results produce specific results; L.O.1.4 To collect data and statistics to test and evaluate to generate statements and predictions of patterns, to discover useful information in the decision process; L.O.1.5 To compare the performance of alternative vehicles based on selected factors; Cp2. Software design and development capability L.O.2.1. to develop software for motor vehicles and related systems; L.O. 2.2 understand and apply the principles of programming and software development technologies in the automotive industry; L.O.2.3 to evaluate and choose suitable platforms, programming languages and software technologies for projects in the automotive industry; L.O.2.4 to develop software applications to improve the functionality, performance and safety of motor vehicles; L.O.2.5 to test and troubleshoot software to ensure the proper and safe operation of vehicle systems;
Transversal competences	Ct1. Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts; L.O.2.6 to be able to lead others, coordinate a team; L.O.2.7 be able to train other team members and organize information, objects and resources; L.O.2.8 to motivate others, stimulating action; L.O.2.9 to develop teams, managing time and delegating responsibilities; L.O.2.10 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Theoretical and practical training in the energy management of the electrical , electronic, and mechatronics systems of the vehicles
7.2 Specific objectives	• Development of the ability of the graduate to use various algorithms of optimization. • Development of the working abilities with the latest device in the domain. • Solving specific problems, paper elaboration and calculation methods

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. Introduction	Presentation; Conversation (Use of teaching materials presented with video projector) Demonstration (use of representative real devices)	2	
2. Batteries. Types, characteristics, integration in the energetic system of the hybrid vehicle		4	
3. Supercapacitors. Integration in the energetic system of the hybrid vehicle		4	
4. Systems based on supercapacitors and batteries		4	
5. Combustion fuels, integration in the energetic system for large vehicles		2	
6. Energetic management for hybrid vechiles using neutral networks		6	
7. Simulation using Simulink-Matlab		3	
8. Energy management for transport fleets		3	
Bibliography 1. Curtis Darrel Anderson, Judy Anderson – Electric and hybrid cars: a history, McFarland, 2005. 2. Xi Zhang, Chris Mi– Power Systems: Vehicle Power Management: Modeling, Control and Optimization, Springer-Verlag London, 2011 3. Andreas Gaede– Automotive Electrical Energy Management System, Glyndwr University, 2010			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Project implementation: - battery systems for vehicles - supercapacitor-based systems for vehicles - mixed systems for vehicles - optimization of consumption for hybrid vehicles using neutral systems - simulation of diverse systems using the Simulink - Matlab software	Use of specific software	28	

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

The curriculum responds to the current requirements regarding the skills that automotive industry specialists must have.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Written	Written exam	
	- Knowledge of concepts; - The ability to apply the accumulated knowledge; - The language appropriate to the subject; - Attitude towards learning	The subjects cover the key chapters of the course.	60%
10.5 Seminar/ laboratory/ project	Project defend		
	- Degree of involvement while conducting the experiments; - Rhythm of activity; keeping the calendar; - Ability to understand phenomena	- Direct and systematic observation; - Record progress - Project defend	40%
10.6 Minimal performance standard			
• The final average is calculated only if the student gets a minimum of 5 points at the project defend			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA Dean	Prof.dr.ing. Mihai Duguleana Head of departament
Postelnicu Cristian-Cezar Course holder	Postelnicu Cristian-Cezar Holder of laboratory

Note:

1) Field of study – select one of the following options: BA/MA/PhD. (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: BA/MA/PhD;

3) Course status (content) – for the BA level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the MA level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Modelling and virtual collision testing					
2.2 Course convenor			Prof. Ph. D. Eng. Nicolae ISPAS					
2.3 Seminar/ laboratory/ project convenor			Lecturer Ph. D. Eng. Ionut Alexandru RADU					
2.4 Study year	2	2.5 Semester	3	2.6 Evaluation type	E	2.7 Course status	Content[3)]	DC
							Attendance type[4)]	EC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/1/1**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/14/14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	42
Additional documentation in libraries, specialized electronic platforms, and field research	32
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	14
Tutorial	2
Examinations	4
Other activities.....	4

3.7 Total number of hours of student activity	94
3.8 Total number per semester	150
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• strength of materials, materials technology, computer assisted design, finite element analysis, passive vehicle safety, vehicle calculation and construction, vehicle dynamics
4.2 competences-related	• Operating with fundamental concepts of engineering sciences, Matlab, SIMULINK, advanced using computer skils

5. Conditions (if applicable)

5.1 for course development	• projector • lecture notes • recommended bibliography
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers

	• lecture notes • recommended bibliography

6. Specific competences and learning outcomes

Professional competences	C.3 Competencies for carrying out tests and practical determinations L.O.3.1 To perform experimental, environmental and operational tests on models, prototypes or on systems and equipment to test their resistance and capabilities in normal and extreme conditions; L.O.3.2 To interpret and analyze data collected during testing, to formulate conclusions, new perspectives or solutions. L.O.3.3 To record the data that was specifically identified during the previous tests, to check if the results of the test produce specific results; L.O.3.4 To collect data and statistics in order to test and evaluate in order to generate statements and predictions of patterns, with the aim of discovering useful information in the decision process; L.O.3.5 To simulate and test mechatronic units using appropriate equipment; L.O.3.8 To test mechatronic units using appropriate equipment, collecting and analyzing data. To monitor and evaluate the performance of the system and take measures, if necessary. CP.4 Competences to carry out scientific research. L.O.4.2 To gather information about current trends and styles regarding vehicles and the need for new products or services; L.O.4.3 To prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep up with recent discoveries; L.O.4.4 To prepare research documents or give presentations to report the results of an ongoing research project, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results; L.O.4.7 To manage research data; L.O.4.8 To operate scientific research and laboratory equipment; L.O.4.9 To synthesize information, critically interpret and summarize new and complex information from various sources; C.5 Ability to design and develop software L.O.5.5 to test and debug software to ensure the proper and safe operation of vehicle systems; C.6 Skills to use CAD-CAM-CAE systems L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.6.3 using computer-aided engineering programs to perform stress analyzes for engineering projects. C.8 The ability to improve safety and comply with technical equipment safety standards L.O.8.1 inspect equipment used during industrial activities, such as manufacturing or construction equipment, to ensure that the equipment complies with safety and environmental legislation. L.O.8.2 combine mechanical, electrical, electronic, software and safety engineering to design motor vehicles such as trucks, vans and cars. L.O.8.3 to apply the basic security standards and technical standards specific to equipment to prevent risks related to the use of technical equipment at work.
Transversal competences	Ct1. Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments;

	L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts; L.O.2.6 to be able to lead others, coordinate a team; L.O.2.7 be able to train other team members and organize information, objects and resources; L.O.2.8 to motivate others, stimulating action; L.O.2.9 to develop teams, managing time and delegating responsibilities; L.O.2.10 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Understanding the principles and potential for using advanced PC-CrashIntegrated Development Environments for automotive design. • Understand and gain advanced knowledge required to develop applications for dynamic simulation of vehicle systems based on Matlab and C++. • Understanding how to apply basic modeling techniques and tools to develop Simulink block diagrams
7.2 Specific objectives	• Learning of knowledge for creating dynamic simulation of vehicle systems required in automotive design; • Learning knowledge for the development of PC-Crash software applications; • Acquirement of practical skills for automotive design applications through the use of PC-Crash programming environments. • Creating Simulink models and simulating system dynamics • Modeling continuous-time, discrete-time, and hybrid systems • Building hierarchy into a Simulink model

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Physical-mathematical models used to study vehicle collisions. Legislation Used to Evaluate Car Performance in Collisions	Exposure, plans, figures, schemes, video elements	6 hours	
Implementation of software and physical-mathematical models used by car collision analysis. Package software used to analyze and model collisions involving vehicles. Software used to	Exposure, plans, figures, schemes, video elements	4 hours	

analyze and model collisions involving vehicles			
Modeling vehicle-to-vehicle accidents	Exposure, plans, figures, schemes, video elements	6 hours	
Elements of Biomechanics. Models of occupants and pedestrians. Multibody systems.	Exposure, plans, figures, schemes, video elements	4 hours	
Simulation of vehicle-pedestrian accidents	Exposure, plans, figures, schemes, video elements	2 hours	
FE analysis for virtual modeling of plastic deformation of some elements in the vehicle structure.		4 hours	
Virtual tests for deformable parts of vehicle body.	Exposure, plans, figures, schemes, video elements	2 hours	

Bibliografie

1. Șoica, A., Siguranța pasivă a autovehiculelor, Editura Universității Transilvania din Brașov, Brașov 2010, ISBN 978-973-598-739-8.
2. Beleș, H., Șoica, A., Siguranța activă și pasivă a autovehiculelor, Editura Universității din Oradea, Oradea 2011, ISBN 978-606-10-0651-9.
3. Ispas, N., Șoica, A., Beleș, H., Expertiza si dinamica accidentelor rutiere, Editura Universității din Oradea, Oradea 2011, ISBN 978-606-10-0652-6.
4. Șoica, A., Chiru, A., Ispas, N., Huminic, A., Caroserii și sisteme pentru siguranță pasivă I, Editura Universității Transilvania din Brașov, Brașov 2005, ISBN 973 – 635 – 460 – 1.
5. Șoica, A., Caroserii și sisteme pentru siguranța pasiva II, Editura Universității Transilvania din Brașov, Brașov 2008, ISBN 978 – 973 – 598 – 354 – 3.
6. Câmpian, V.O., Șoica, A., Încercarea și omologarea autovehiculelor, Editura Universității Transilvania din Brașov, ISBN 973 – 735 – 306 – 0 Brașov, 2004
7. Șoica, A., s.a., Caroserii și sisteme pentru siguranța pasivă, Reprografia Universității Transilvania din Brașov – 2003.
8. Nahum, A.M., Melvin, J.W., Accidental Injury, ed. Springer – Verlag, 1996.
9. PC-CRASH 12.0 – Manual de Utilizare, DSD- Dr. Steffan Datentechnik, Austria, 2018.
10. ***Standarde internaționale pentru manechine antropometrice destinate încercărilor de coliziune la impact lateral. ISO/TR 9790-1-6.
11. ***Standarde internaționale privind omologarea și testarea la coliziune a autovehiculelor (R 29 – ECE ONU, R – ECE ONU, R 42 – ECE ONU, R 96 – ECE ONU, NHTSA 214).

8.2 ~~Seminar~~/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Vehicle to vehicle accident modeling	Using PC-Crash 15.0 software	8	
Vehicle - pedestrian accident modeling	Using PC-Crash 15.0 software	4	
Modeling occupant / pedestrian behavior using multibody systems	Using PC-Crash 15.0 software	4	
Calculation of injury criteria for occupants on various body segments.	PC_Crash, MathCad	2	
Determination of the deformations and overall stiffness of the structure by virtual modeling of the collision tests	PC_Crash, MathCad	4	

Determination by FEA of the deformations of some elements of the car's resistance structure	PC_Crash, MathCad	4	
Student final evaluation	PC_Crash, MathCad	2	
Vehicle to vehicle accident modeling	Using PC-Crash 15.0 software	8	
Vehicle - pedestrian accident modeling	Using PC-Crash 15.0 software	4	
Modeling occupant / pedestrian behavior using multibody systems	Using PC-Crash 15.0 software	4	
Calculation of injury criteria for occupants on various body segments.	PC_Crash, MathCad	2	
Determination of the deformations and overall stiffness of the structure by virtual modeling of the collision tests	PC_Crash, MathCad	4	
Determination by FEA of the deformations of some elements of the car's resistance structure	PC_Crash, MathCad	4	
Student final evaluation	PC_Crash, MathCad	2	

Bibliography

Șoica, A., Siguranța pasivă a autovehiculelor, Editura Universității Transilvania din Brașov, Brașov 2010, ISBN 978-973-598-739-8.

2. Beleș, H., Șoica, A., Siguranța activă și pasivă a autovehiculelor, Editura Universității din Oradea, Oradea 2011, ISBN 978-606-10-0651-9.

3. Ispas, N., Șoica, A., Beleș, H., Expertiza si dinamica accidentelor rutiere, Editura Universității din Oradea, Oradea 2011, ISBN 978-606-10-0652-6.

4. Șoica, A., Chiru, A., Ispas, N., Huminic, A., Caroserii și sisteme pentru siguranță pasivă I, Editura Universității Transilvania din Brașov, Brașov 2005, ISBN 973 – 635 – 460 – 1.

5. Șoica, A., Caroserii și sisteme pentru siguranța pasiva II, Editura Universității Transilvania din Brașov, Brașov 2008, ISBN 978 – 973 – 598 – 354 – 3.

6. Câmpian, V.O., Șoica, A., Încercarea și omologarea autovehiculelor, Editura Universității Transilvania din Brașov, ISBN 973 – 735 – 306 – 0 Brașov, 2004

7. Șoica, A., s.a., Caroserii și sisteme pentru siguranța pasivă, Reprografia Universității Transilvania din Brașov – 2003.

8. Nahum, A.M., Melvin, J.W., Accidental Injury, ed. Springer – Verlag, 1996.

9. PC-CRASH 12.0 – Manual de Utilizare, DSD- Dr. Steffan Datentechnik, Austria, 2018.

10. ***Standarde internaționale pentru manechine antropometrice destinate încercărilor de coliziune la impact lateral. ISO/TR 9790-1-6.

11. ***Standarde internaționale privind omologarea și testarea la coliziune a autovehiculelor (R 29 – ECE ONU, R 26 –ECE ONU, R 42 – ECE ONU, R 96 – ECE ONU, NHTSA 214).

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

- The requirements of the Romanian Motor Vehicle Engineers Society (SIAR);
- Society of Automotive Engineers (SAE USA) requirements;
- EVU Association Europe;
- SC SCHAEFER - Romania SA;
- SC DACIA GROUP RENAULT SA;
- SC FORD Romania SA;
- SC AUTOLIV Romania SA.

Theoretical and practical approaches demonstrate the latest programming IDE for automotive design. The curriculum is consistent with similar fields addressed to universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Ability to operate with assimilated knowledge	Written exam	50%
10.5 Seminar/ laboratory/ project	Ability to apply in practice the assimilated knowledge	Project	50%
10.6 Minimal performance standard			
Development of a project that uses principles and methods specific to the field of mechanical engineering: • Knowledge of the fundamental elements of PC_Crash solving dynamic simulation task. • Implement a dynamic vehicle system model in Simulink. • The grades obtained for the project and exam must be at least 5			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dL.Ong. Ioan Călin ROȘCA, **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** **Head of Department**
Prof. Ph. D. Eng. Nicolae ISPAS **.....** **Course holder**	Lecturer Ph. D. Eng. Ionut Alexandru RADU **.....** **Holder of seminar/ laboratory/ project**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Automotive Design

2. Data about the course

2.1 Name of course			Virtual manufacturing in automotive technologies					
2.2 Course holder			prof.dr.ing. BUTNARIU Silviu					
2.3 Seminar/ laboratory/ project convenor			prof.dr.ing. BUTNARIU Silviu					
2.4 Study year	2	2.5 Semester	1	2.6 Evaluation type	E	2.7 Discipline status	Content[2)]	PC
							Attendance type[3)]	EC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 course	**2**	3.3 seminar/ laboratory/ project	**0/0/2**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 course	28	3.6 seminar/ laboratory/ project	0/0/28

Time allocation	hours
Study of textbooks, course support, bibliography and notes	40
Additional documentation in libraries, specialized electronic platforms, and field research	30
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	22
Tutorial	
Examinations	2
Other activities.....	

3.7 Total number of individual learning hours	94
3.8 Total number per semester	150
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 to the curriculum	• technical drawing, general concepts of physics, mechanics, strength of materials, machine parts, machine tools, manufacturing technologies, robotics, virtual reality.
4.2 to competences	• design manufacturing technologies for road vehicles;

5. Conditions (if applicable)

5.1 of course development	classroom, projector
5.2 of seminar/ laboratory/ project development	computer room, dedicated software, testing equipment (flexible manufacturing cell), machine parts; laboratory guide

6. Specific competences

Professional competences	C.3 Competencies for carrying out tests and practical determinations L.O.3.1 To perform experimental, environmental and operational tests on models, prototypes or on systems and equipment to test their resistance and capabilities in normal and extreme conditions; L.O.3.2 To interpret and analyze data collected during testing, to formulate conclusions, new perspectives or solutions. L.O.3.3 To record the data that was specifically identified during the previous tests, to check if the results of the test produce specific results; L.O.3.4 To collect data and statistics in order to test and evaluate in order to generate statements and predictions of patterns, with the aim of discovering useful information in the decision process; L.O.3.5 To simulate and test mechatronic units using appropriate equipment; L.O.3.8 To test mechatronic units using appropriate equipment, collecting and analyzing data. To monitor and evaluate the performance of the system and take measures, if necessary. CP.4 Competences to carry out scientific research. L.O.4.2 To gather information about current trends and styles regarding vehicles and the need for new products or services; L.O.4.3 To prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep up with recent discoveries; L.O.4.4 To prepare research documents or give presentations to report the results of an ongoing research project, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results; L.O.4.7 To manage research data; L.O.4.8 To operate scientific research and laboratory equipment; L.O.4.9 To synthesize information, critically interpret and summarize new and complex information from various sources; C.5 Ability to design and develop software L.O.5.5 to test and debug software to ensure the proper and safe operation of vehicle systems; C.6 Skills to use CAD-CAM-CAE systems L.O.6.1 the use of computer-aided design (CAD) systems to contribute to the creation, modification, analysis and optimization of an industrial drawing or model; L.O.6.3 using computer-aided engineering programs to perform stress analyzes for engineering projects. C.8 The ability to improve safety and comply with technical equipment safety standards L.O.8.1 inspect equipment used during industrial activities, such as manufacturing or construction equipment, to ensure that the equipment complies with safety and environmental legislation. L.O.8.2 combine mechanical, electrical, electronic, software and safety engineering to design motor vehicles such as trucks, vans and cars. L.O.8.3 to apply the basic security standards and technical standards specific to equipment to
Transversal competence	Ct1. Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments; L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts;

7. Discipline objectives (resulting from the specific competences to be acquired)

7.1 General discipline objective	Thorough theoretical and applied technologies and virtual reality techniques and / or augmented Thorough theoretical and applied in the design, manufacture, testing and maintenance of motor development
7.2 Specific objectives	Theoretical and practical knowledge about the structure, design and design devices and software modules for RV and AR. Practical skills of operating systems and hardware-software operating RV. Theoretical and practical knowledge related to all stages of product development (concept, design, manufacture, operation) practical skills simulation of automotive product development

8. Content

8.1 Course	Teaching methods	Hours	Remarks
1. Getting on the production of goods. 2. Working machines. Classification of machine tools. 3. Conventional machine tools. Manufacturing processes. 4. General principles of technological processes. 5. About the concept of virtual manufacturing 6. Software used in virtual manufacturing 7. Work machine control 8. CNC of machine tools 9. Command and control systems for machine tools; 10. CNC Manual programming 11. Software used to control CNC machine tools; 12. Flexible manufacturing cells 13. Using the software CAD / CAM 14. Design and virtual manufacturing using dedicated software	Interactive course, exposure to multimedia.	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	

Bibliography

- Morar, Liviu – Maşini, roboti si echipamente pentru sisteme flexibile de fabricație, curs, Universitatea Tehnica din Cluj Napoca, 2006.
- Gyenge Cs. Frățilă D., Ingineria fabricatei, curs Universitatea Tehnică din Cluj-Napoca, Facultatea Construcții de Maşini, 2004.
- Delmia software – Documentation (http://www.3ds.com/support/download-documentation/resource-library/)

8.2 Seminar/ laboratory/ project	Teaching-learning methods	Hours	Remarks
1. Technologies for manufacturing automotive components	Learning through problem / explanation, demonstration, case study, conducting guided and independent applications.	2	Weekly
2. Identification and classification of CNC machine tools. The axis control machine		2	
3. Presentation of CNC machine tools, types of control panels. Identification codes		2	
4. Used software for commands of CNC machine tools. Manual programming of CNC machine tools (G-code)		2	
5. Processing simulation of machine parts on CNC machine using specialized software. Using the software CAD / CAM. Transformation and transmission CAM programs to CNC machine tools.		4	
6. Visit an automotive production plant (4 hrs)		2	
7. Virtual operation system for CNC machine tools (mil land turn)		2	

8. Virtual operation system for CNC machine tools using G code (ISO)		2	
9. Virtual operation system for industrial robots		2	
10. Automatic tracking of the parts flow in the auxiliary system of a flexible		2	
11. Virtual operation system for a flexible manufacturing cell		2	
12. Organizing the fabrication flow using specialized software		2	
13. Evaluation		2	

Bibliography:

- Delmia software – Documentation (http://www.3ds.com/support/download-documentation/resource-library/) ;
- Technical book CNC EMCO
- Technical book SINUMERIK

9. Corroboration of the discipline content with the expectations of the epistemic communities' representatives, the professional associations, and representative employers for the study programme

In corroboration with Industrial Companies interests. A large number of representative employers recognize that modeling and simulation, computer-aided design (CAD) engineering methods (CAE) and computer aided manufacturing (CAM) are valuable tools in development to optimize the vehicle design and manufacture, as well as minimize risks

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	An ability to identify, formulates, and solves engineering problems.	Written examination	50%
	Course activity	Are registered in the course.	10%
10.5 Seminar/ laboratory/ project	Practical problems abilities	Practical work/oral presentation	40%
10.6 Minimal performance standard			
Mark 6 for laboratory. Correct operation of the fundamental concepts in the field of theoretical and applied discipline.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA Dean of Faculty of Mechanical Engineering	Prof.dr.ing. Mihai Duguleana Head of Departament Automotive and Transportation Engineering
Prof.dr.ing. Silviu BUTNARIU Course holder	Prof.dr.ing. Silviu BUTNARIU Holder of seminar/ laboratory

Note:

1) Field of study – select one of the following options: BA/MA/PhD. (to be filled in according to the forceful classification list for study programmes);
2) Study level – choose from among: BA/MA/PhD;

[3] Course status (content) – for the BA level, select one of the following options: FC (fundamental course) / DC (course in the study domain)/ SC (speciality course)/ CC (complementary course); for the MA level, select one of the following options: PC (proficiency course)/ SC (synthesis course)/ AC (advanced course);

[4] Course status (attendance type) – select one of the following options: CPC (compulsory course)/ EC (elective course)/ NCPC (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Sensory and control systems of vehicles					
2.2 Course convenor			Lecturer PhD Eng. Postelnicu Cristian-Cezar					
2.3 Seminar/ laboratory/ project convenor			Lecturer PhD Eng. Postelnicu Cristian-Cezar					
2.4 Study year	2	2.5 Semester	3	2.6 Evaluation type	E	2.7 Course status	Content[3)]	SC
							Attendance type[4)]	EC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 lecture	**2**	3.3 seminar/ laboratory/ project	**0/2/0**
3.4 Total number of hours in the curriculum	56	out of which: 3.5 lecture	28	3.6 seminar/ laboratory/ project	0/14/0

Time allocation	hours
Study of textbooks, course support, bibliography and notes	40
Additional documentation in libraries, specialized electronic platforms, and field research	28
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	20
Tutorial	4
Examinations	2
Other activities.....	0

3.7 Total number of hours of student activity	94
3.8 Total number per semester	150
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 curriculum-related	• Applied electronics
4.2 competences-related	•

5. Conditions (if applicable)

5.1 for course development	• Lecture room with multimedia equipment and minimum 25 places
5.2 for seminar/ laboratory/ project development	• Lecture room with multimedia equipment, electronic components and materials, and minimum 25 places

6. Specific competences and learning outcomes

Professional competences	CP.1 Adjusts product designs L.O.1.1.4 The graduate has the ability to study, interpret and capitalize on technical resources specific to the automotive industry; C.3 Anticipates changes in automotive technology L.O.3.1.1. The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. C.5 – Automobile construction L.O.5.1.2. The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. C.6 Controls production L.O.6.1.1. The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. L.O.6.3.1. The graduate demonstrates autonomy in learning on issues specific to the field. C.7 Conducts market research L.O.7.1.1. The graduate analyzes and argues theoretical, experimental results and technical documentation associated with the field of automotive engineering. C.8 Conducts scientific research L.O.8.2.1 The graduate is able to operate scientific and laboratory research equipment; C.12 Designs and executes the virtual model of a product L.O.12.2.6 The graduate has the ability to effectively communicate the results of modeling and simulation. L.O.12.2.7 The graduate has the ability to integrate various software tools and manage data transfer between them. C.16 Designs the user interface L.O.16.1.3 The graduate has in-depth knowledge of specific programming techniques and languages. L.O.16.2.1 The graduate has the ability to analyze the requirements and project specification.
Transversal competences	CT.1 Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence L.O.1.9 apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment CT.2 Communication and teamwork skills L.O.2.1 to carry out their work in a team

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Acquiring knowledge and forming basic skills in designing and maintaining auto control systems.

7.2 Specific objectives	• Knowledge of the types of control systems in vehicles; • Understanding the role of control systems in vehicles and their operating principles; • Knowledge of the structure of the control systems and the functional role of the components; • Acquiring practical and practical skills in the field of electrical measurements.

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
1. Introduction to computerized systems in motor vehicles: - Typical structure of control systems; - The specifics of automotive control systems; - Functions of control systems; - Requirements and performance of control systems in motor vehicles.	Presentation; Conversation (Use of teaching materials presented with video projector) Demonstration (use of representative real devices)	4	
2. Sensors used in motor vehicles: Design, operation and destination of sensors: - Pressure; - Acceleration (accelerometers); - Oxygen (lambda); - Speed; - Position / Distance - Rotation (gyroscopes); - temperature; - Humidity; - Light.		10	
3. Data communication in motor vehicles: - Types of networks used in motor vehicles; - CAN network; - LIN network - The FlexRay Network.		8	
4. Control systems in motor vehicles: - Traction control system; - Dynamics control system; - Safety and comfort control system - Communication and navigation system; - Control system for information and entertainment; - The diagnosis system.		6	

Bibliography
1. De Silva, C.W., Sensors and Actuators Engineering System Instrumentation, Taylor and Francis Inc., 2015
2. D. Patranabis, Sensors and Transducer, PHI Learning Pvt. Ltd., 2004.
ISBN 973–9428–96–9,
3. Drugă, C.,N., Cojocaru, A., Senzori şi traductoare electrice, Vol.I şi II, Editura Universită ii "Transilvania" Braşov, 2009.
4. A.C.Stanca, Senzori si traductoare, curs în format electronic, UnivTB, 2012.
5. A.C.Stanca, Contribu ii la sistemele de control ale autovehiculelor ce utilizează supercondensatoare, teză de doctorat, UniTBV, 2010.
6. Turner, J., Automotive Sensors, Momentum Press, 1 March 2009, ISBN: 1606500090.

7. NI Tutorial "FlexRay Automotive Communication Bus Overview" http://zone.ni.com/devzone/cda/tut/p/id/3352.			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
1. Study of pressure sensors used in motor vehicles	Demonstration, experiment, direct action, problem-solving	2	
2. Study of acceleration sensors used in motor vehicles		2	
3. Study of temperature and position sensors used in motor vehicles		4	
4. Study of DC motors and step-by-step		2	
5. Study of non-critical control systems (windscreen, doors, lighting, mirrors, etc.)		4	
Bibliography 1. A.C.Stanca, Senzori si traductoare, Îndrumar de laborator în format electronic, UnivTB, 2012 2. S. Barrett, D. Pack, "Atmel AVR Microcontroller Primer: Programming and interfacing", Morgan&Claypool, 2008. 3. J. Oxer, H. Blemings, Practical Arduino: Cool Projects for Open Source Hardware (Technology in Action), Apress, 2009			

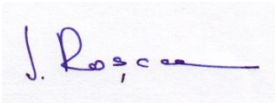
9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

The curriculum responds to the current requirements regarding the skills that automotive industry specialists must have.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Written	Written exam	
	Knowledge of concepts; - The ability to apply the accumulated knowledge; - The language appropriate to the subject; - Attitude towards learning	The subjects cover the key chapters of the course: sensors, actuators, communications, and automotive control systems.	70%
10.5 Seminar/ laboratory/ project	Laboratory defend		
	- Degree of involvement while conducting the experiments; - Rhythm of activity; keeping the calendar; - Attitude towards laboratory activities; - Ability to understand phenomena	- Direct and systematic observation; - Record progress - Laboratory defend	30%
10.6 Minimal performance standard			
The final average is calculated only if the student gets a minimum of 5 points at the laboratory defend and minimum 5 points for the written exam.			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof. PhD Eng.Ioan Calin ROSCA **Dean** 	**Prof. PhD Eng. Mihai DUGULEANA** **Head of Department** 
Lecturer PhD Eng. Cristian-Cezar POSTELNICU **Course holder** 	**Lecturer PhD Eng. Cristian-Cezar POSTELNICU** **Holder of laboratory** 

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Automotive Design

2. Data about the course

2.1 Name of course			Automotive mechatronics systems					
2.2 Course holder			prof.dr.ing. MOGAN Gheorghe					
2.3 Seminar/ laboratory/ project convenor			prof.dr.ing. MOGAN Gheorghe					
2.4 Study year	2	2.5 Semester	1	2.6 Evaluation type	E	2.7 Discipline status	Content[2)]	SC
							Attendance type[3)]	EC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**4**	out of which: 3.2 course	**2**	3.3 seminar/ laboratory/ project	**0/2/0**
3.4 Total number of hours in the curriculum	28	out of which: 3.5 course	28	3.6 seminar/ laboratory/ project	0/28/0

Time allocation	hours
Study of textbooks, course support, bibliography and notes	40
Additional documentation in libraries, specialized electronic platforms, and field research	28
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	20
Tutorial	4
Examinations	2
Other activities.....	

3.7 Total number of individual learning hours	94
3.8 Total number per semester	150
3.9 Number of credits[5)]	6

4. Prerequisites (if applicable)

4.1 to the curriculum	• Navigate the courses: Fundamentals of Electronics and Computer, Virtual instrumentation.
4.2 to competences	• Results after completion of the above courses.

5. Conditions (if applicable)

5.1 of course development	• Classroom equipped with multimedia equipment and minimum capacity of 25 seats
5.2 of seminar/ laboratory/ project development	• Laboratory room, with board, equipped with specific systems, minimum 13 seats.

6. Specific competences

Professional competences	CP. 2. Competences in the design of systems, equipment and vehicle components R.I.2.2 the use of advanced concepts, techniques and principles regarding the design of modern systems and equipment for motor vehicles CP. 3. R.I.3.8 To test mechatronic units using appropriate equipment, collecting and analyzing data. To monitor and evaluate the performance of the system and take measures, if necessary. CP. 4 Competences to carry out scientific research R.I.4.8 To operate scientific research and laboratory equipment CP. 5 Software design and development capability R.I.5.2. understand and apply the principles of programming and software development technologies in the automotive industry R.I.5.3 to evaluate and choose suitable platforms, programming languages and software technologies for projects in the automotive industry CP. 8 The ability to improve safety and comply with technical equipment safety standards R.I.8.2 combine mechanical, electrical, electronic, software and safety engineering to design motor vehicles such as trucks, vans and cars
Transversal competences	CT.1 Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence R.I.1.9 apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment CT.2 Communication and teamwork skills R.I.2.1 to carry out their work in a team

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General discipline objective	Acquiring knowledge and basic skills training in mechatronic systems design for automotive fields.
7.2 Specific objectives	◘ Knowledge of the types of mechatronic systems from auto vehicles; ◘ Understanding the role of automotive mechatronic systems and their operating principles; ◘ Knowledge of mechatronic systems structure and functional role of components; ◘ Design of the uncritical mechatronic systems for vehicles.

8. Content

8.1 Course	Teaching methods	Hours	Remarks
Introduction into the structure of mechatronic systems of vehicles: - Typical structure of mechatronic systems; - Specifics of mechatronic systems in auto vehicles; - Functions of mechatronic systems in auto vehicles; -Requirements and performance of automotive me systems.	Exposure; Conversation (Use of teaching materials provided with the projector)	1 hour	

2. Mechatronic systems sensors used in motor vehicles: Construction, operation and destination mechatronic systems sens to automotive: - Pressure; - Acceleration (accelerometers); - Oxygen (Lambda); - Speed; - Position / Distance; - Rotation (gyroscopes);	Exposure; Conversation (Use of teaching materials provided with the projector) Demonstration (use real devices representative)	4 hours	
3. Actuators used in the automotive mechatronic systems: Construction, operation and destination: - DC motors; - Stepper motors;		3 hours	
4.Data communication between mechatronic systems: - Types of networks used in automotive; - Networks CAN / K-line; - LIN networks;	Exposure; Conversation (Use of teaching materials provided with the projector)	3 hours	
5. Automotive mechatronic control systems: - Central command and control system (ECU) - Traction Control System (TCS / ASR / ABS / ESP / ESC.) - System Dynamics Control (VDIM / DSTC); - The safety and comfort control (ACC LDWS, airbag, climate); - Diagnostic System (ISO 14230-4, ISO 15765-4)		2 hours	
6. Current trends in the field: - Mechatronic devices; - Full integration (power, analog, digital, sensors, actuators, pr storage, communication);		1 hour	
Bibliography [1] Intelligent Mechatronic Systems Modeling, Control and Diagnosis Merzouki, R., Samantaray, A.K., Path Ould Bouamama, B. 2013 [2] Mechatronic Systems: Fundamentals, Rolf Isermann, 2005 [3] Mechatronic Systems Analysis, Design and Implementation Boukas, El-Kébir, Al-Sunni, Fouad M. 2011			
8.2 Seminar/ laboratory/ project	Teaching-learning meth		Remarks
8.2.1 Laboratory			
1. Study K-line communication system (ISO 14230-4).	Demonstration experiment, direct action, problems.	2 hours	
2. Study ABS system		2 hours	
3. Study AIRBAG, DSTC systems		4 hours	
4. Study of DC motor and stepper motor		2 hours	
5. Study of non-critical control systems (climate, windscreen, doors mirrors, etc.).		4 hours	
Bibliography [1] Intelligent Mechatronic Systems Modeling, Control and Diagnosis Merzouki, R., Samantaray, A.K., Pathak, P. Bouamama, B. 2013 [2] Mechatronic Systems: Fundamentals, Rolf Isermann, 2005 [3] Mechatronic Systems Analysis, Design and Implementation Boukas, El-Kébir, Al-Sunni, Fouad M. 2011			

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Research in the field of electronic control of automotive systems; Testing and approval in the field of car manufacturing; Diagnosis and repair within the SERVICE units

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	An ability to apply knowledge of mathematics, science, and engineering. An ability to identify, formulates, and solves engineering problems.	Theoretical and practical examination – project, case study	50%
10.5 Seminar/ laboratory/ project	An ability to design a system, component or process to meet desired needs.	Laboratory	15%
	An ability to use techniques, skills, and modern engineering tools necessary for engineering practices; project - case study	Applications test, exercises	35%
• Participation in the exam is conditional on the complete laboratory work and the promotion of the laboratory colloquium.			
10.6 Minimal performance standard			
Minimum requirements for 5 - for all assessment activities: to obtain minimum score awarded half of respectively minimum 5. Minimum standards of performance are given by: o Diagnosis of the electronic systems of cars using specific equipment. o Repair of mechatronic systems by replacing defective modules. o Testing the components of mechatronic systems using domain specific stands			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA Dean of Faculty of Mechanical Engineering	Prof.dr.ing. Mihai Duguleana Head of Departament Automotive and Transportation Engineering
Prof.dr.ing. Gheorghe MOGAN Course holder	Prof.dr.ing. Gheorghe MOGAN Holder of seminar/ laboratory

Note:

1) Field of study – select one of the following options: BA/MA/PhD. (to be filled in according to the forceful classification list for study programmes);
2) Study level – choose from among: BA/MA/PhD;
3) Course status (content) – for the BA level, select one of the following options: FC (fundamental course) / DC (course in the study domain)/ SC (speciality course)/ CC (complementary course); for the MA level, select one of the following options: PC (proficiency course)/ SC (synthesis course)/ AC (advanced course);
4) Course status (attendance type) – select one of the following options: CPC (compulsory course)/ EC (elective course)/ NCPC (non-compulsory course);
5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transportation
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			Practice for research and development I					
2.2 Course convenor								
2.3 Seminar/ laboratory/ project convenor			Prof. Ph. D. eng. Florin GÎRBACIA					
2.4 Study year	2	2.5 Semester	3	2.6 Evaluation type	V	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	**NCPC**

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**12**	out of which: 3.2 lecture	**0**	3.3 seminar/ laboratory/ project	**0/0/12**
3.4 Total number of hours in the curriculum	168	out of which: 3.5 lecture	0	3.6 seminar/ laboratory/ project	168

Time allocation	hours
Study of textbooks, course support, bibliography and notes	
Additional documentation in libraries, specialized electronic platforms, and field research	
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	
Tutorial	
Examinations	
Other activities.....	

3.7 Total number of hours of student activity	168
3.8 Total number per semester	168
3.9 Number of credits[5)]	5

4. Prerequisites (if applicable)

4.1 curriculum-related	• Elementary concepts of automotive engineering, computer-aided design
4.2 competences-related	• Operating with fundamental concepts of engineering sciences.

5. Conditions (if applicable)

5.1 for course development	• projector
5.2 for seminar/ laboratory/ project development	• projector • laboratory equipped with computers • Windows operating system, Matlab

6. Specific competences and learning outcomes

Professional competences	C1. Skills for identifying needs for design L.O.1.1 To identify customer needs, using appropriate questions and active listening to identify customer expectations, wishes and requirements according to products and services; L.O.1.2 To interpret the technical requirements of customers, analyzing, understanding and applying the information provided regarding the technical conditions; L.O.1.3 To define technical design requirements, by specifying the technical properties of the goods, materials, methods, processes, services, systems, software and functionalities, by identifying and addressing the specific needs that must be met according to the client's requirements; L.O.1.4 To ensure the connection with the engineers from the other departments to ensure a common understanding and to discuss the design, development and improvement of the products; L.O.1.5 To make design sketches to contribute to the development and communication of design concepts. C2 Competences in the design of systems, equipment and vehicle components L.O.2.1 To carry out scientific research, to conceive or create new knowledge by formulating questions in the field by researching, improving or developing concepts, theories, models, techniques, tools, software or operational methods and by using methods and techniques scientific; L.O.2.2 To gather information about current trends and styles regarding vehicles and the need for new products or services; L.O.2.3 To prepare reports that describe the results and processes of scientific or technical research or evaluate its progress. These reports help researchers keep up with recent discoveries; L.O.2.4 To prepare research documents or give presentations to report the results of an ongoing research project, indicating the analysis procedures and methods that led to the respective results, as well as possible interpretations of the results; L.O.2.5 To synthesize information, critically interpret and summarize new and complex information from various sources; L.O.2.6 To interact professionally in research and professional environments; L.O.2.7 To apply systematic research methods and to communicate with the relevant parties to find specific information, evaluating the research results in view of the relevant estimation of the information, as well as the related technical systems and their evolutions; L.O.2.8 To provide proof of in-depth knowledge and complex understanding of the research field, including responsible research, ethical principles and scientific integrity in research matters, respect for private life and GDPR requirements, related to research activities in - a certain discipline. C3 Skills in using CAD-CAM -CAE systems L.O.3.1 using computer-aided engineering programs to perform stress analyzes for engineering projects. C4 The ability to improve safety and comply with technical equipment safety standards L.O.4.1 combine mechanical, electrical, electronic, software, and safety engineering to design motor vehicles such as trucks, vans, and automobiles. C.8 The ability to improve safety and comply with technical equipment safety standards L.O.8.1 inspect equipment used during industrial activities, such as manufacturing or construction equipment, to ensure that the equipment complies with safety and environmental legislation. L.O.8.3 to apply the basic security standards and technical standards specific to equipment to prevent risks related to the use of technical equipment at work.
Transversal competences	Ct1. Integration skills in specific workplace activities and technical skills, in conditions of autonomy and professional independence L.O.1.1 to assume responsibility, to accept responsibility for their own decisions, showing willingness to work, respecting their commitments;

	L.O. 1.2 to show determination, making sustained efforts for success pursuing clear objectives, to make decisions choosing from several alternative possibilities; L.O.1.3 to show initiative, to be proactive, L.O.1.4 to apply scientific, technological and engineering knowledge, processing complex information, operating technological installations, tools or digital equipment; L.O.1.5 identify problems and make decisions to solve them; L.O.1.6 to comply with the rules, regulations and guidelines related to a certain field or sector and to apply them in his day-to-day activity; L.O.1.7 to plan activities, manage the calendar and resources to complete tasks in a timely manner. Ct2. Communication and teamwork skills L.O.2.1 to carry out their work in a team; L.O. 2.2 to address an audience, give a speech, make a presentation; L.O.2.3 to moderate discussions between two or more people, including in situations such as workshops, conferences or online events; L.O.2.4 to use simple digital tools and technologies to communicate, interact and collaborate with others. L.O.2.5 to negotiate compromises, showing trust and managing the frustration of team members, to find compromise solutions, resolving conflicts; L.O.2.6 to be able to lead others, coordinate a team; L.O.2.7 be able to train other team members and organize information, objects and resources; L.O.2.8 to motivate others, stimulating action; L.O.2.9 to develop teams, managing time and delegating responsibilities; L.O.2.10 to create and maintain networks, promoting ideas, products and services.

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Apply scientific knowledge to solve automotive engineering problems.
7.2 Specific objectives	• Practical skills for simulating the development processes of automotive products. • Practical skills for working with integrated software packages for controlling mechatronic systems of vehicles • Practical skills of advanced simulation in the design of vehicles • Development of modern software, innovative methods, principles and simulation procedures • Development of methods for evaluating research and development projects • Developing a management strategy using modern principles and methods

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Not the case			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
Clutch model in Simulink	Presentations, examples, experiments, research on the dynamic simulation of the vehicle systems, virtual collision modeling and testing, the sensory and control systems of the vehicles, virtual	168	
The suspension system in Simulink			
Servo electro-hydraulic control in Simulink			
Development of a C ++ application for dynamic simulation of a vehicle			
Group projects			

	instrumentation		

Bibliography

1. Gîrbacia, F. Computer Aided Design and Graphics Programming. Editura Universită ii Transilvania, Braşov, 2016.
2. https://www.mathworks.com/examples/simulink/category/automotive-applications
3. https://www.computoolable.nl

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

Through its content and through the elaboration of the thematic portfolio (the study), the masters acquire competences in accordance with the expectations of the epistemic community and of the producers in the car market. The analytical program is in line with similar fields addressed at universities in the country and abroad.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course			
10.5 Seminar/ laboratory/ project	Completion of simulations in Simulink	Oral presentation	100%
	Development of the C ++ program		
	Involvement in practical activities		
	Efficiency in verbal communication (presentation)		
	Completion of simulations in Simulink		
10.6 Minimal performance standard			

- Knowledge of Simulink and C++ fundamentals
- Realization of a Simulink simulation for engineering applications
- Realization of practical project
- The marks for project work must be at least 5.

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Prof.dr.ing. Ioan Călin ROȘCA, **Dean**	**Prof. dr. ing. Mihai DUGULEANĂ,** **Head of Department**
Prof. Ph. D. eng. Florin GÎRBACIA,	Prof. Ph. D. eng. Florin GÎRBACIA,

Course holder	Holder of seminar/ laboratory/ project

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

2) Study level – choose from among: Bachelor / Master / Doctorat;

3) Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

4) Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

5) One credit is the equivalent of 25 study hours (teaching activities and individual study).

COURSE OUTLINE

1. Data about the study programme

1.1 Higher education institution	Transilvania University of Brasov
1.2 Faculty	Mechanical Engineering
1.3 Department	Automotive and Transport Engineering
1.4 Field of study[1)]	Automotive Engineering
1.5 Study level[2)]	Master
1.6 Study programme/ Qualification	Virtual Engineering in Automotive Design

2. Data about the course

2.1 Name of course			University ethics					
2.2 Course convenor								
2.3 Seminar/ laboratory/ project convenor			Senior lecturer Simona ŞOICA, PhD					
2.4 Study year	II	2.5 Semester	IV	2.6 Evaluation type	V	2.7 Course status	Content[3)]	PC
							Attendance type[4)]	CPC

3. Total estimated time (hours of teaching activities per semester)

3.1 Number of hours per week	**1**	out of which: 3.2 lecture	**0**	3.3 seminar/ laboratory/ project	**1**
3.4 Total number of hours in the curriculum	14	out of which: 3.5 lecture	0	3.6 seminar/ laboratory/ project	14

Time allocation	hours
Study of textbooks, course support, bibliography and notes	10
Additional documentation in libraries, specialized electronic platforms, and field research	12
Preparation of seminars/ laboratories/ projects, homework, papers, portfolios, and essays	12
Tutorial	
Examinations	2
Other activities.....	

3.7 Total number of hours of student activity	36
3.8 Total number per semester	50
3.9 Number of credits[5)]	2

4. Prerequisites (if applicable)

4.1 curriculum-related	
4.2 competences-related	• Communication and academic writing

5. Conditions (if applicable)

5.1 for course development	
5.2 for seminar/ laboratory/ project development	• Room equipped with projector/TV, board and marker.

6. Specific competences and learning outcomes

Professional competences	
Transversal competences	Ct.1 Competences for integration into specific workplace activities, and technical competences, showing autonomy and professional independence Learning Outcomes. The graduate of the master study program is able to: L.O.1.1. assume responsibility for his/her decisions, show willingness to work, meet commitments; L.O.1.2. show determination, make decisions by identifying new opportunities; L.O.1.3. show initiative, be proactive; L.O.1.4. show self-reflection, thinki quickly and accept constructive criticism from colleagues or superiors; L.O.1.5 . analyze new issues as they arise, drawing on creative, innovative, analytical, holistic thinking; L.O.1.6. ensure customer orientation; L.O.1.7. identify problems and make decisions to solve them; L.O.1.8. comply with the rules, regulations and guidelines related to a specific field or sector and apply them in his/her daily work; Ct.2 Communication and teamwork skills Learning Outcomes. The graduate of the master study program is able to: L.O.2.1. carry out his/her work in a team; L.O.2.2. address an audience, deliver visual presentation of data; L.O.2.3. coordinate communication in a group, including situations such as workshops, conferences or online events; L.O.2.4 use simple digital tools and technologies to communicate, interact and collaborate with others. L.O..2.5 be able to lead others and coordinate a team; L.O..2.6. be able to train other team members and organize information, objects and resources

7. Course objectives (resulting from the specific competences to be acquired)

7.1 General course objective	• Ethics in scientific research
7.2 Specific objectives	• Adapt and apply scientific writing rules in line with international standards. • Managing professional writing

8. Content

8.1 Course	Teaching methods	Number of hours	Remarks
Bibliography			
8.2 Seminar/ laboratory/ project	Teaching-learning methods	Number of hours	Remarks
8.2.1. Scientific discourse; Importance of ethics in scientific research.	Problematization. Applications	1	
8.2.2. Elaboration of academic and scientific work: Documentation, Research. Scientific databases	Problematization. Applications	2	
8.2.3. Elaboration of academic and scientific work: thesis, hypotheses, research methods	Problematization. Applications	2	
8.2.4. Elaboration of academic and scientific work:	Problematization.	2	

Research methods in engineering	Applications		
8.2.5. Elaboration of academic and scientific work: Organizing texts, writing the abstract;	Problematization. Applications	2	
8.2.6. Elaboration of academic and scientific work: Adapting internationally agreed styles;	Problematization. Applications	2	
8.2.7. Writing technical/scientific texts (technical reports, instructions, procedures, user manuals);	Problematization. Applications	2	

Bibliography

Alley, M. (2018) *The craft of scientific writing*. New York: Springer.

Bailey, S. (2003) *Academic Writing: A practical guide for students*. London: Routledge.

Barrass, R. (2002) *Scientists Must Write: A guide to better writing for scientists, engineers and students*. London: Routledge.

Laplante, P.A. (2012) *Technical writing*. Boca Raton: CRC Press Taylor & Francis Group.

Marder, M. P. (2011). *Research methods for science*. Cambridge: Cambridge University Press.

Thiel, D. V. (2014). *Research methods for engineers*. Cambridge: Cambridge University Press

9. Correlation of course content with the demands of the labour market (epistemic communities, professional associations, potential employers in the field of study)

- Academic and scientific rigor and honesty;
- Adapt technical writing skills to the future workplace

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course			
10.5 Seminar/ laboratory/ project	Applying seminar concepts	Written exam	100%
10.6 Minimal performance standard			
• Complying with the rules of scientific writing and obtaining the passing grade			

This course outline was certified in the Department Board meeting on 08/09/2025 and approved in the Faculty Board meeting on 09/09/2025.

Professor Ioan-Călin ROȘCA, PhD **Dean**	**Professor Mihai DUGULEANĂ, PhD** **Head of Department**
	Senior lecturer Simona ȘOICA, PhD **Holder of seminar**

Note:

1) Field of study – select one of the following options: Bachelor / Master / Doctorat (to be filled in according to the forceful classification list for study programmes);

[2] Study level – choose from among: Bachelor / Master / Doctorat;

[3] Course status (content) – for the Bachelor level, select one of the following options: **FC** (fundamental course) / **DC** (course in the study domain)/ **SC** (speciality course)/ **CC** (complementary course); for the Master level, select one of the following options: **PC** (proficiency course)/ SC (synthesis course)/ **AC** (advanced course);

[4] Course status (attendance type) – select one of the following options: **CPC** (compulsory course)/ **EC** (elective course)/ **NCPC** (non-compulsory course);

[5] One credit is the equivalent of 25 study hours (teaching activities and individual study).