

SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Automotive Engineering, Mechatronics and Mechanics
1.3	Department	Automotive Engineering and Transportation
1.4	Field of study	Automotive Engineering
1.5	Cycle of study	Master's in Science
1.6	Program of study/Qualification	Tehnici Avansate în Ingineria Autovehiculelor (Advanced Techniques in Automotive Engineering) - în limba engleză
1.7	Form of education	Full time
1.8	Subject code	13.00

2. Data about the subject

2.1	Subject name				Hardware and Software in the Loop						
2.2	Subject area				Automotive Engineering						
2.3	Course responsible/lecturer				Associate Professor PhD Iclodean Călin calin.iclodean@auto.utcluj.ro						
2.4	Teachers in charge of seminars				Associate Professor PhD Iclodean Călin calin.iclodean@auto.utcluj.ro						
2.5	Year of study	II	2.6	Semester	3	2.7	Assessment	E	2.8	Subject category	DA/DI

3. Estimated total time

3.1	Number of hours per week	4	3.2	of which, course:	2	3.3	applications:	2
3.4	Total hours in the curriculum	100	3.5	of which, course:	28	3.6	applications:	28
Individual study								hours
Manual, lecture material and notes, bibliography								16
Supplementary study in the library, online and in the field								16
Preparation for seminars/laboratory works, homework, reports, portfolios, essays								10
Tutoring								-
Exams and tests								2
Other activities								-
3.7	Total hours of individual study	44						
3.8	Total hours per semester	100						
3.9	Number of credit points	4						

4. Pre-requisites (where appropriate)

4.1	Curriculum	-
4.2	Competence	General knowledge in the fields of automotive, electronics and computer science.

5. Requirements (where appropriate)

5.1	For the course	-
5.2	For the applications	Attending (100% attendance) and performing (promoting) the activities from the laboratory applications condition the admission to the final form of evaluation of the discipline.

6. Specific competences

Professional competences	Ability to describe, explain and demonstrate the operation of the main command and control systems and equipment in the field of automobile construction. Knowledge of the functional role of the main command and control systems and equipment in the field of car construction. Knowledge of some typologies of architectures for the communication networks used in the construction of vehicles and the deepening of the main physical and virtual models used in the development and validation of these communication networks. Knowledge of possible faults and the way, respectively of the repair procedures. Knowledge of the advantages of using command and control systems in the construction of vehicles developed in physical and virtual environments.
Cross competences	Oral and written communication skills in the mother tongue / foreign language. Use of information and communication technology. Execution of professional tasks according to the specified requirements following a pre-established work plan under qualified guidance. Completion of homework and projects imposed on time and at a high-quality standard. Integration within a working group, assuming specific roles and achieving good communication within the team. Achieving personal and professional development, efficiently using own resources and modern study tools.

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

7.1	General objective	Development of specific skills in the field of command-and-control systems and equipment in the field of automobile construction in support of professional training.
7.2	Specific objectives	Assessment and analysis of requirements for new technologies integrated in vehicles in order to implement advanced command and control systems.

8. Contents

8.1. Lecture (Syllabus)	Methods	Notes
1. In-Vehicles ECU (Electronic Control Unit) basic characteristics	Exposure, conversation, exemplification, orientation, etc. Use of technical and visual means.	2 hours
2. Virtual ECU (Electronic Control Unit) for Powertrain Domain		2 hours
3. Virtual ECU (Electronic Control Unit) for Chassis and Safety Domain		2 hours
4. Virtual ECU (Electronic Control Unit) for Body and Confort Domain		2 hours
5. Virtual ECU (Electronic Control Unit) for Infotainment Domain		2 hours
6. Virtual ECU (Electronic Control Unit) for Telematic Domain		2 hours
7. Embedded System development based on the "V" Model		2 hours
8. Model-in-the-Loop (MiL) model development methodology		2 hours
9. Software-in-the-Loop (SiL) model development methodology		2 hours
10. Processor-in-the-Loop (PiL) model development methodology		2 hours
11. Hardware-in-the-Loop (HiL) model development methodology		2 hours
12. AUTOSAR Classic Architecture and AUTOSAR Adaptive Architecture		2 hours
13. AUTOSAR Application Interface of the Classic Platform Release for Vehicle Domains		2 hours
14. Automotive SPICE Process Assessment / Reference Model		2 hours
8.2. Applications/Seminars	Methods	Notes
1. XiL (X-in-the-Loop) development methods in simulation applications	Exercices, conversations,	2 hours

2. Defining a virtual model based on a real model (1) in simulation application	description, modeling, etc. Use of technical and visual means.	2 hours
3. Defining a virtual model based on a real model (2) in simulation application		2 hours
4. Defining a virtual model based on a real model (3) in simulation application		2 hours
5. XiL (X-in-the-Loop) development: virtual ECU modeling (1)		2 hours
6. XiL (X-in-the-Loop) development: virtual ECU modeling (2)		2 hours
7. XiL (X-in-the-Loop) development: virtual ECU modeling (3)		2 hours
8. Testing and optimizing virtual ECU model (1) parameters in simulation application		2 hours
9. Testing and optimizing virtual ECU model (2) parameters in simulation application		2 hours
10. Testing and optimizing virtual ECU model (3) parameters in simulation application		2 hours
11. Analysis and interpretation of simulation results for virtual ECU model (1)		2 hours
12. Analysis and interpretation of simulation results for virtual ECU model (2)		2 hours
13. Analysis and interpretation of simulation results for virtual ECU model (3)		2 hours
14. Evaluation of individual assignment		2 hours
Bibliography		
1. Bosch Automotive Electrics and Automotive Electronics Systems and Components (link).		
2. Bosch Automotive Mechatronics, Automotive Networking, Electronics (link).		
3. Bosch Diesel Engine Management, Systems and Components (link).		
4. Bosch Gasoline Engine Management Systems and Components (link).		
5. Bosch Fundamentals of Automotive and Engine Technology, Standard Drives (link).		
6. Iclodean Autonomous Vehicles for Public Transportation (link).		
7. Iclodean Introducere în sistemele automobilelor (link).		
8. Iclodean Metode de Simulare a Sistemelor de Propulsie prin Aplicații Numerice (link).		
9. Iclodean Rețele de Comunicație pentru Autovehicule (link).		
10. Iclodean Interconectarea sistemelor virtuale de ... control pentru autovehicule (link).		
11. Isermann Automotive Control Modeling and Control of Vehicles (link).		
12. Burnete Motoare cu Ardere Internă si termodinamică. Noțiuni fundamentale (link).		
13. Varga Electric and Plug-In Hybrid Vehicles Advanced Simulation Methodologies (link).		
14. Varga Electric and Hybrid Buses for Urban Transport Energy Efficiency Strategies (link).		
15. AUTOSAR Standard Classic Platform (link).		
16. AUTOSAR Standard Adaptive Platform (link).		
17. AUTOSAR Application Interface (link).		
18. Automotive SPICE Process Reference/Assessment Model (link).		

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

In the training of skills, the options of employers recommended to higher education institutions for the training of graduates are taken into account (ability to use time efficiently, ability to work in a team, ability to learn quickly, ability to coordinate teams, new opportunities in the interest company, the ability to use the computer and the Internet, the ability to adapt to new situations, etc.) and the priorities recommended by employers in training graduates (creativity and ability to innovate, the ability to negotiate, the ability to critically analyze, the ability to learn quickly, knowledge from other fields). The content of the discipline is in accordance with the study materials and methods that are used at other universities in the country and abroad.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The degree of assimilation of the notions presented during the course. Correctness of acquired knowledge.	Written evaluation.	60%
10.5 Applications	Ability to operate with assimilated knowledge.	Checking applications.	40%
10.6 Minimum standard of performance: final grade 5.			

Date of filling in:		Title Surname Name	Signature
24.06.2025	Lecturer	Associate Professor PhD Iclodean Călin	
	Teachers in charge of application	Associate Professor PhD Iclodean Călin	

Date of approval in the department ART 24.06.2025 _____	Head of department Prof.dr.ing. Barabás István
Date of approval in the faculty ARMM 25.06.2025 _____	Dean Prof.dr.ing. Filip Nicolae