SYLLABUS

1. Program data

1.1 Higher education institution	Technical University of Cluj-Napoca
1.2 Faculty	Road Vehicles, Mechatronics and Mechanics
1.3 Department	Road Vehicles and Transport
1.4 Field of study	Automotive Engineering
1.5 Study cycle	Master's Degree
1.6 Study program / Qualification	Advanced Techniques in Automotive Engineering (English) /Engineer
1.7 Form of education	IF – full-time education

2. Data about the discipline

2.1 Name of the discipline	Electric and hybrid powertrains					Code of Discipline	7.00
2.2 Course holder	Prof. PhD Habil. Eng. Bogdan Ovidiu VARGA – Bogdan.varga@auto.utcluj.ro						
2.3 Head of ~~seminar~~/laboratory/~~project/practical activities~~	Prof. PhD Habil. Eng. Bogdan Ovidiu VARGA – Bogdan.varga@auto.utcluj.ro						
2.4 Year of study	1	2.5 Semester	2	2.6 Type of Assessment			E
2.7 Discipline regime	Formative category						DS
	Optionality						DOB

3. Total estimated time

3.1 Number of hours per week	3	of which:	3.2 Lecture	2	3.3 Seminary	0	3.3 Laboratory	1	3.3 Project	0	3.3 Practice	0
3.4 Number of hours per semester	42	of which:	3.5 Lecture	28	3.6 Seminary	0	3.6 Laboratory	14	3.6 Project	0	3.3 Practice	0

3.7 Distribution of time (hours per semester) for individual study and assessment:	
(a) Assessment	4
(b) Studying according to the textbook, course material, bibliography and notes	20
(c) Additional documentation in the library, on specialized electronic platforms and in the field	20
(d) Preparation of seminars / laboratories, assignments, papers, portfolios and essays	10
(e) Tutoring	4
(f) Other activities	-
3.8 Total hours of individual study and assessment (sum of (3.7(a)…3.7(f))	58
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credits	4

4. Preconditions (where applicable)

4.1 Curriculum	
4.2 Skills	

5. Conditions (where applicable)

5.1. Lecture delivery	
5.2. Seminar / laboratory / project delivery	

6. Specific skills acquired

Professional skills	The student will be able to understand to develop and to evaluate the energy flow in the hybrid and electric vehicle powertrain. He will accumulate knowledge in the field of electrification of the vehicle. He will accumulate knowledge in terms of electric motors, batteries for electric and hybrid propulsion. He will be able to evaluate the range of a electric vehicle due to battery capacity, energy storage level, environmental temperature.
Transversal skills	The student will be able to attend evaluate various sources of propulsion covering electrical motor to internal combustion.

7. Expected learning outcomes

Knowledge	The student/graduate demonstrates advanced knowledge of electric and hybrid powertrain architectures, operating principles, energy conversion processes, and energy management strategies used in modern road vehicles. The student/graduate explains the characteristics, performance, and integration of electric machines, power electronics, energy storage systems, and hybrid propulsion technologies.
Skills	The student/graduate analyzes, models, and evaluates the performance and energy efficiency of electric and hybrid powertrain systems using modern engineering methods and simulation tools. The student/graduate selects appropriate propulsion architectures and components, evaluates their operational performance, and proposes engineering solutions for improving vehicle efficiency, sustainability, and environmental performance.
Responsibility and autonomy	The student/graduate independently evaluates electric and hybrid propulsion technologies, justifies engineering decisions based on technical, economic, and environmental criteria, and applies professional standards in solving complex automotive engineering problems. The student/graduate demonstrates responsibility in the development and assessment of sustainable propulsion solutions, while effectively communicating technical results and collaborating in multidisciplinary engineering teams.

8. The objectives of the discipline (based on the grid of specific competencies acquired)

8.1 General objective of the discipline	The general objective is to accumulate knowledge in the filed of vehicle electrification.
8.2 Specific objectives	- evaluate and understand the energy flow in the hybrid vehicle - evaluate and understand the energy flow in the electric vehicle.

9. Content

9.1 Lecture	**Hrs.**	**Teaching methods**	**Observation**
1. Principles of Modelling and Simulation Processes.	2	Lectures, interactive discussions, practical examples, and case studies.	
2. Mathematics Behind the Models	2		
3. Engine models	2		
4. Powertrain models	2		
5. Virtual Powertrain Design	2		
6. Classical Powertrain Configuration Model and Simulation	2		
7. Hybrid Powertrain Configuration Model and Simulation	2		
8. Electric Powertrain Configuration Model and Simulation	2		
9. Creating Virtual Road Infrastructure	2		
10. Energy efficiency road dependent.	2		
11. Energy efficiency temperature dependent.	2		

9.1 Lecture	Hrs.	Teaching methods	Observation
12. Simulation in the loop	2		
13. Hardware in the loop	2		
14. Real vs simulated environment	2		
References: 1. ELECTRIC AND PLUG-IN HYBRID VEHICLES 2015 AUTHORS-Bogdan Ovidiu Varga • Florin Mariasiu • Dan Moldovanu • Calin Iclodean , ISBN: 9783319186382 • 9783319186399, DOI: 10.1007/978-3-319-18639-9			

9.2 Seminar / laboratory / project / practice	Hrs.	Teaching methods	Observation
1. Simulation environment, AVL Cruise vehicle components	2	Practical exercises, demonstrations, modeling, and computer-aided simulation.	
2. AVL Cruise vehicle connections, AVL Cruise standard vehicle model	2		
3. AVL Cruise hybrid vehicle model, AVL Cruise electric vehicle model	2		
4. AVL Cruise standard vehicle simulation, AVL Cruise hybrid vehicle simulation	2		
5. AVL Cruise electric vehicle simulation, AVL Cruise electric/hybrid vehicle energy flow – road depended	2		
6. AVL Cruise electric/hybrid vehicle energy flow –temperature depended, AVL Cruise electric/hybrid vehicle energy flow – battery state of charge dependent	2		
7. CarMaker electrical/hybrid vehicle simulation environment, CarMaker electrical/hybrid vehicle energy flow –road depended	2		
References: 1. AVL Cruise laboratory notes- practical usage 2. CarMaker laboratory notes- practical usage.			

10. Correlating the content of the discipline with the expectations of representatives of the epistemic community, professional associations and representative employers in the field related to the program

The courses and the curricula are developed in close connection with Porsche Engineering.

11. Evaluation

Activity	11.1 Assessment criteria	11.2 Assessment methods	11.3 Weight of final grade
11.4 Lecture	General subjects evaluation	Written examination (summative assessment)	70%
11.5 Seminar/Laboratory /Project / Practice	Appreciation of the work during the laboratories	Continuous assessment based on laboratory activities	30%
11.6 Minimum Performance Standard Each subject must be solved, minimum grade 5(five) Know the models from AVL CRUISE and identify components and how they work. Know the schematics of a classic, hybrid and electric vehicle and the description of the components.			

Date of completion	Responsible	Grade, Title, Second name First NAME	Signature
09.07.2026	Lecture	*Prof. PhD. Habil. Eng. Bogdan Ovidiu VARGA*	
	Applications	*Prof. PhD. Habil. Eng. Bogdan Ovidiu VARGA*	

Date of approval in the ART Department Council 24.07.2026 _____	ART Department Director Prof.dr.ing. Barabás István
Date of approval in the ARMM Faculty Council 16.09.2026 _____	Dean, Prof.dr.ing. Filip Nicolae