SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of 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 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	07.00

2. Data about the subject

2.1	Subject name			Electric and Hybrid Powertrains		
2.2	Subject area			Automotive Engineering		
2.2	Course responsible/lecturer			Prof. PhD Habil. Eng. Bogdan Ovidiu VARGA – Bogdan.varga@auto.utcluj.ro		
2.3	Teachers in charge of seminars			Prof. PhD Habil. Eng. Bogdan Ovidiu VARGA – Bogdan.varga@auto.utcluj.ro		
2.4 Year of study	I	2.5 Semester	II	2.6 Assessment	E	
2.7 Subject category	Formative category				DA	
	Optionality				DI	

3. Estimated total time

3.1 Number of hours per week	3	of which	3.2 Course	2	3.3 Seminar	0	3.3 Laborator	1	3.3 Proiect	0
3.4 Total hours in the curriculum	42	of which	3.5 Course	28	3.6 Seminar	0	3.6 Laborator	14	3.6 Proiect	0

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	20
(b) Supplementary study in the library, online and in the field	20
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	11
(d) Tutoring	5
(e) Exams and tests	2
(f) Other activities	-

3.8 Total hours of individual study (summ (3.7(a)...3.7(f)))	58
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	
4.2	Competence	Simulation engineering software, vehicle calculus and construction

5. Requirements (where appropriate)

5.1	For the course	
5.2	For the applications seminarului / laboratorului / proiectului	

6. Specific competences

Professional competences	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.
Cross competences	The student will be able to attend evaluate various sources of propulsion covering electrical motor to internal combustion.

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

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

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
1. Principles of Modelling and Simulation Processes.	2	Presentation, discussions	
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		
12. Simulation in the loop	2		

13. Hardware in the loop	2		
14. Real vs simulated environment	2		
Bibliography 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			
8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
1. Simulation environment, AVL Cruise vehicle components	2	Presentations, applications	
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		
Bibliography 1. AVL Cruise laboratory notes- practical usage 2. CarMaker laboratory notes- practical usage			

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

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

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	General subjects evaluation	Written evaluation	70%
10.5 Seminars /Laboratory/Project	To create a vehicle in a simulation environment	Computer simulation	30%
10.6 Minimum standard of performance			
Laboratory work– minimum grade 5(five) 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 filling in:		**Title Surname Name**	**Signature**
10.06.2024	Lecture	Prof. PhD. Habil. Eng. Bogdan Ovidiu VARGA	
	Teachers in charge of application	Prof. PhD. Habil. Eng. Bogdan Ovidiu VARGA	

Date of approval in the department ART
26.06.2024
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Head of department
Prof.PhD.Eng. Barabás István

Date of approval in the faculty ARMM
28.06.2024
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Dean
Prof.PhD.Eng. Filip Nicolae