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	Advanced Techniques in Automotive Engineering
1.7	Form of education	Full time
1.8	Subject code	14.00

2. Data about the subject

2.1	Subject name			Thermal Management of Vehicle Powertrain		
2.2	Subject area			Automotive Engineering		
2.2	Course responsible/lecturer			Lecturer PhD Eng. Levente KOCSIS		
2.3	Teachers in charge of seminars			Assist. PhD Eng. Thomas BUIDIN		
2.4 Year of study	2	2.5 Semester	1	2.6 Assessment		Exam
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 Seminary	-	3.3 Laboratory	1	3.3 Project	-
3.4 Total hours in the curriculum	42	of which	3.5 Course	28	3.6 Seminary	-	3.6 Laboratory	14	3.6 Project	-

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	30
(b) Supplementary study in the library, online and in the field	24
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	25
(d) Tutoring	2
(e) Exams and tests	2
(f) Other activities	

3.8 Total hours of individual study (summ (3.7(a)…3.7(f)))	83
3.9 Total hours per semester (3.4+3.8)	125
3.10 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1	Curriculum	
4.2	Competence	General competences regarding electrical equipment, IC engines, simulation models

5. Requirements (where appropriate)

5.1	For the course	Lecture room, laptop, video projector
5.2	For the applications seminary/ laboratory / project	Laboratory equipped with the following software: KULI. The attendance (100% presence) and the completion (completion / promotion) of the activities from the applications condition the admission to the final form of assessment of the discipline

6. Specific competences

Professional competences	- Should be able to identify, to define and to use specific notions regarding thermal management. - Should be able to use KULI thermal management software for modelling and simulation of specific systems.
Cross competences	Social interaction: - applying the techniques of effective multidisciplinary team work on various hierarchical levels in the team; - expression through written and oral communication in technical language of theoretical and practical elements of automotive thermal management; - the ability to share and debate upon information acquired from the automotive thermal management classes.

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

7.1	General objective	to understand the possibilities and to be able to implement the strategies thermal management offers in the CO_2 reduction battle
7.2	Specific objectives	- to understand the importance of modern thermal management solutions; - to gain elaborate knowledge on key cooling modules; - to be able to implement the gained knowledge in a thermal management simulation software.

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
1. The Importance of Heat Transfer. Types of heat transfer.	2	Explanation, description, presentation, analysis, illustration.	
2. Thermal transfer and energy balance of the engine. Thermal demand and temperature distribution of components.	2		
3. Functional analysis of air conditioning systems (regulators, bases of comfort in the passenger compartment).	2		

4. Principles of thermal management (vehicles equipped with internal combustion engine, hybrids and electric vehicles).	2		
5. Internal combustion engine cooling system. Intercooling systems.	2		
6. Cooling the exhaust gas recirculation system. Electric pumps, intelligent thermostats, electric actuators.	2		
7. Thermal management of electric motors.	2		
8. Thermal management of inverters.	2		
9. Thermal management of battery packs.	2		
10. Alternative cooling and heating methods in electric vehicles.	2		
11. Thermal management of transmission units.	2		
12. The heat flow inside the vehicle and to various propulsion systems.	2		
13. Thermal management control. Healing of heat according to needs.	2		
14. The impact of thermal management on fuel consumption and autonomy, on comfort and performance of the vehicle.	2		

Bibliography

1. Bennion, K., Thornton, M., *Integrated Vehicle Thermal Management for Advanced Vehicle Propulsion Technologies*, SAE World congress, Michigan, 2010;
2. Dincer, I., Hamut, H., Javani, N., Thermal Management of Electric Vehicle Battery Systems, John Wiley & Sons, ISBN13 9781118900246, 2017
3. Hiereth, H., Prenninger, P., Charging the Internal Combustion Engine, Springer-Verlag, Wien, 2003, ISBN 978-3-211-33033-3
4. Heywood B. John, *Internal Combustion Engine Fundamentals*, McGraw-Hill, New York, 1988;
5. Gursaran, M., *Vehicle Thermal Management,* Published by SAE International with a Product Code of PT-97, ISBN of 978-0-7680-1445-7, and 420 pages in a softbound binding, 2004;
6. T. Yomi Obidi, *Thermal management in automotive applications*, Published by SAE International with a Product Code of PT-167, ISBN of 978-0-7680-8174-9, 108 pages in a softbound binding, 2015;
7. Wagner, J., Srinivasan, V., Dawson, D., and Marotta, E., "*Smart Thermostat and Coolant Pump Control for Engine Thermal Management Systems*," SAE 2003-01-0272, 2003;
8. Wagner, J., Ghone, M., Dawson, D., and Marotta, E., "*Coolant Flow Control Strategies for Automotive Thermal Management Systems*," SAE 2002-01-0713, 2007.

8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
1. Introduction to KULI thermal management software, interface, functions	2	KULI Software	

2. Modelling/simulation of heat flow/transfer in KULI software	2		
3. Battery cooling/heating necessities as a function of battery cell type	2		
4. Modelling a battery management system for a HEV vehicle, with regard to different battery types	2		
5. Evaluation of power consumption of the system	2		
6. Discussing results, future optimization possibilities.	2		
7. Evaluation	2		

Bibliography

1. Bennion, K., Thornton, M., *Integrated Vehicle Thermal Management for Advanced Vehicle Propulsion Technologies*, SAE World congress, Michigan, 2010;
2. Dincer, I., Hamut, H., Javani, N., Thermal Management of Electric Vehicle Battery Systems, John Wiley & Sons, ISBN13 9781118900246, 2017
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8. Wagner, J., Ghone, M., Dawson, D., and Marotta, E., "*Coolant Flow Control Strategies for Automotive Thermal Management Systems*," SAE 2002-01-0713, 2007.

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

The competences accumulated will be needed for employees who are active in the field of motor vehicle engineering. Competence training takes into account the employers' options recommended to higher education institutions for graduate training (ability to effectively use time, teamwork skills, ability to learn quickly, the ability to coordinate teams, new opportunities in the company's interest, 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 innovation capacity, ability to negotiate, critical and autocratical analysis ability, ability to learn quickly , knowledge from other fields).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade

10.4 Course	A written final test	will have theoretical topics, each topic will have to be addressed	75%
10.5 Seminars /Laboratory/Project	Final evaluation of the work	Presenting the laboratory work	25%
10.6 Minimum standard of performance			
Minimum knowledge: Understand the principles of thermal management of internal combustion engines, battery batteries and transmissions. Minimum competencies: Implementation of an internal combustion engine in KULI and energy consumption assessment. Performing the laboratory work according to the requirements and presentation of the laboratory dossier - minimum 5 (five) Each subject in the test has to be resolved - minimum score 5 (five)			

Date of filling in:		**Title Surname Name**	**Signature**
23.06.2025	Lecturer	Lecturer PhD Eng. Levente KOCSIS	
	Teachers in charge of application	Assist. PhD Eng. Thomas BUIDIN	

Date of approval in the department of Automotive Engineering and Transportation __24.06.2025_____	Head of department Prof.dr.ing. István BARABÁS
Date of approval in the Faculty of Automotive Engineering, Mechatronics and Mechanics _25.06.2025_____	Dean Prof.dr.ing. Nicolae FILIP