1	Course Number	Study Programme	Semester	Offered in	Duration	Course Type	Workload (h)	ECTS Points
		INTAP	3-7	☒WS	1 Semester	optional		4

2	Courses	Teaching and Learning Forms	Contact Time (SWS)	Contact Time (h)	Self-Study Time (h)	Language
		Lectures, practices and exam preparation	4 (1h=45 min.)	**40**	20	English

3 **Learning outcomes and competences**

After successfully completing the module, students will be able to ...

Know and understand

- ... recognize all types of vehicle transmissions and understand their functional scope
- ... recognize and justify the most important engine concepts
- ... describe the design of important components
- ... describe functional groups and their influence
- ... understand and describe power flow in drive trains
- ... describe system optimization for electric drives
- ... describe operating strategies for hybrid vehicles
- ... describe thermal interactions in the powertrain
- ... know and understand common and special drive structures

Use, application and generation of knowledge

Use and transfer

- ... Carry out basic design of electric drives
- ... Carry out control of electric drives.
- ... Perform optimization calculations for conventional, electric and electrified powertrains.
- ... Perform control of the entire drive system.

Scientific innovation

- ... analyze measurement results from laboratory tests on the engine test bench.
- ... Design operating strategies and interpret their effect on the overall system.
- ... Analyze longitudinal dynamic parameters of powertrains.

Scientific self-image/professionalism

- ... justify the developed solution theoretically and methodically.
- ... reflect and assess their own abilities in a group comparison.
- ... prepare an engineering test report.

4 **Course contents**

Part 1 Basics on components

- Vehicle performance: Demands for drivelines
- Propulsion Systems Basics
- Electrical Systems
- Gearboxes and Components
- Combustion Engines
- Powertrain Simulation using Matlab/Simulink

Part 2 Powertrain Development

- ICE-driven Propulsion Systems
- Hybrid Propulsion Systems
- Pure Electric Propulsion Systems

5 **Participation Requirements**

- Basic knowledge on engines, electrical drives and gearboxes
- Basic knowledge in mechanical design
- Basic knowledge in electrical engineering

6	**Course calendar**		
		Section 1	Section 2
	Week 1	Hybrid Structures	Hybrid Structures
	Week 2	Energy and CO2-equivalents	Energy and CO2-equivalents
	Week 3	Homologation	Exercises
	Week 4	Electrical Components	Analogy Analysis
	Week 5	Operating Strategy	Repetition
	Week 6	mid-term	
	Week 7	Operating Strategies II	Exercises
	Week 8	Thermal Management	Exercises
	Week 9	Combustion Engines	Transmissions
		Hybrid Powertrains fort High Performance	
	Week 10	Applications	Repetition II
	Week 11	final exam	
7	**Examination Forms and Prerequisites for Awarding ECTS Points** Midterm and final exam written examination 90 min., graded The exam is an open book exam and the students can bring all documents (scripts and notes) and calculators.		
8	**Estimated student workload:** 40 hours		
9	**Further Use of course** Electrical Engineering, Mechatronics		
10	**Course Manager and Full-Time Lecturer** Prof. Dr. Franz Berndt		
11	**Literature** Lecture scripts with notes, exam samples with solution, instructor provides exercises.		
12	**Course Registration** Due to the limited number of participants, we ask that you register in advance by emailing kremena.daneva@hs-esslingen.de. You may only participate after receiving confirmation of your registration.		
13	**Last Updated** 30.04.2026		