Propulsion Systems

1	**Module Number**	**Study Program**	**Semester**	**Offered in**	**Duration**	**Module Type**	**Workload**	**ECTS**
	13585	ASM	2	☐WS ☒SS	1 Semester	compulsory	180 h	6

2	**Courses**	**Teaching and Learning Forms**	**Contact Time**		**Self-Study Time**	**Language**
			(SWS)	**(h)**	**(h)**	
	a) Dedicated Hybrid Engines including Controls	Lecture / Exercise	1	15	90	English
	b) Control of Powertrains and Components	Lecture	2	30		
	c) Control Strategies	Lecture	1	15		
	d) Seminar Simulation	Seminar	2	30		

3 **Learning Outcomes and Competences**

Once the module has been successfully completed, the students can...

Knowledge and Understanding

a) Dedicated Hybrid Engines including Controls
- …understand the function and construction of modern combustion engine control systems
- … know and understand concepts of supercharging including Miller-Cycle
- …know about torque based system structure, air-, fuel- and ignition paths
- …know and understand the possibilities of distribution of torque/power in hybrid powertrains
- …understand and explain the scope of functions for recuperation in electrified powertrains

b) Control of Powertrains and Components
- …understand control loops for drive units and drive systems
- …understand and explain the functional scope of control devices in electrified drives
- …understand and explain the coupling of software and hardware

c) Control Strategies
- …identify and explain operating modes of hybrid vehicles
- …know and present operating modes of various powertrains
- …understand and evaluate operating strategies of electric- and hybrid vehicles in detail
- …understand the interaction of components in the powertrain system to optimize consumption and emissions

d) Seminar Simulation
- …understand structure and functionality of powertrain simulation models

Use, Application and Generation of Knowledge

a) Dedicated Hybrid Engines including Controls
- … compare fuel consumption at different loads, speeds and ignition times

b) Control of Powertrains and Components
- … design control of e-drives for electric and hybrid vehicles
- … evaluate concepts of electric drives
- … compare fuel consumption with different loads, speeds, ignition timings
- … calculate resulting speeds, torques, and powers for different powertrain types
- … based on the basic knowledge of common drive components, evaluate new drive structures in terms of essential properties such as performance, smoothness, package or costs

	c) Control Strategies • …design and optimize operating strategies for different hybrid structures • …recognize concept-related restrictions and evaluate operating quality • …compare different operating strategies and evaluate them with regard to consumption, emissions, efficiency and range d) Seminar Simulation • … make use of simulation tools to represent and evaluate interactions in drive systems
4	**Contents** a) Dedicated Hybrid Engines including Controls • Structure of electrical control loops, functions and software. Torque and power paths in hybrid drives, functions, software. b) Control of electrical and electrified powertrains • Structure and function of motor controls; components of motor controls: Sensors, actuators and control unit, structure and function of software, control strategies used. c) Control Strategies • Operating strategies, efficiency increase, emission avoidance, range increase, energy management in the vehicle d) Seminar Simulation • Powertrain simulation
5	**Participation Requirements** compulsory: none recommended: Prior knowledge of propulsion systems from lecture “Vehicle System Fundamentals”
6	**Examination Forms and Prerequisites for Awarding ECTS Points** a), b) and c) Written Examination 90 min (contributing 3/4 to the grade) d) Midterm (contributing 1/4 to the grade)
7	**Further Use of Module** Master Thesis
8	**Module Manager and *Full-Time Lecturer*** Prof. Dr.-Ing. Michael Auerbach, *Prof. Dr.-Ing. Gregor Rottenkolber, Prof. Georg Mallebrein*
9	**Literature** • Reif, Konrad: Grundlagen Fahrzeug- und Motorentechnik im Überblick: Konventioneller Antrieb, Hybridantriebe, Bremsen, Elektrik und Elektronik; Bosch Fachinformation Automobil • Robert Bosch GmbH (Hrsg.): Ottomotor-Management, Vieweg Verlag, 2006 • Robert Bosch GmbH (Hrsg.): Dieselmotor-Management, Vieweg Verlag, 2006 • U. Nuss: Hochdynamische Regelung von Drehstrommaschinen • O. Zirn.: Elektrifizierung in der Fahrzeugtechnik - Grundlagen und Anwendungen, Hanser-Verlag Leipzig 2017 • R. Fischer: Elektrische Maschinen. Hanser Verlag, München Wien 2011 • Peter Hofmann, Hybridfahrzeuge: Ein alternatives Antriebssystem für die Zukunft, Springer 2014
10	**Last Updated** 08.10.2024