Courses 2nd year LUH

Course title	Course contents	Learning outcomes
Electrical Machines and Drives **5 ECTS**	This lecture gives a basic overview and includes knowledge on construction, in-service behaviour and control as well as application range and economic importance of these motors. The lecture is designed for developers of drive systems and for users of small electrical machines in order to support them in the choice of a motor in a specific case of operation.	This lecture gives a basic overview of electrical machine types with special emphasis on small motors and servo drives with an output power smaller than 1 kW.
Electrical Energy Storage **5 ECTS**	Electrical energy storage application areas and their associated business models, storage characteristics and applications,important storage technologies, operational behaviour of energy storages, basic energy storage operation concepts	This course imparts knowledge on the selection and application of electrical energy storage. Successfully completing the modules of this course provide: 1. an overview of important electrical energy storage application areas and their associated business models 2. the ability to calculate important parameters of storage characteristics and storage applications 3. knowledge of important storage technologies, explaining their function, and familiarity with their properties and fields of application 4. the ability to describe/explain the operational behaviour of energy storages based on a simulation model (Unified Energy Model) and how to effectively use the model to calculate storage application (using MS Excel) 5. an understanding of the basic energy storage operation concepts and the ability to formulate basic strategies for selected applications 6. an overview of the approaches for technology selection and dimensioning

Electrical Machines for eAutomotive Traction Applications **5 ECTS**	Introduction, Lecture Overview, Organization, Emobility Market Development & Overview, Power & Torque Requirements for Passenger Cars, WLTC Cycle + Simlified Mass & Drag Model of an Vehicle, Power & Torque Requirements for Electrical Machines, Complex Numbers, PM Machine: Working Principle, Rotating Fields 1: Why m Phases, Rotating Fields 2: Why N Slots, Windings Basic Topologies: Slot / Pole Combinations, Deep Dive: Harmonics 1 & 2, PM Machine: Motor Assembly, PM Machine: Electromagnetic Design, PM Machine: Key Performance Data, Losses and Efficiency, PM Machine: Manufacturing & Costs, Current Excited Synchronous Machine: Working Principle, Current Excited Synchronous Machine: Permance & Efficiency; Tutorials	This course enables students to understand key requirements as well as design challenges for electrical machines in the context of the eAutomotive market. Next to fundamentals and working principles of electrical machines, several design aspects, manufacturing techniques and product costs are covered. Basic and new technologies are presented and compared according to market demands.
Electrothermal Processing (Electrotechnology) **5 ECTS**	Principles of electrotechnologies, energy demand of electrothermal processing; advantages of electrothermal processing against fuel-fired processing; direct and indirect heating methods; fundamentals of direct and indirect heating; fundamentals and applications of direct and indirect resistance heating; fundamentals and applications of induction heating; fundamentals and applications of dielectric heating; calculation, simulation and design of induction heating installations; energy efficiency and CO2 aspects of electrothermal processing.	Learning of fundamentals and applications of principles and the industrial use of electrotechnologies, training in calculation and design of electrothermal processes

Power Electronics **5 ECTS**	Power Electronics for high efficient energy conversion, applications, components, line-commutated converter, DC/DC-Converter, DC/AC-Converter	The lecture gives an introduction into the general topics of modern power electronics with a strong focus on the operation principle of power electronic circuits and their components. After participation the students will be able to explain the basic characteristics of power semiconductors, design passive components for typical applications and calculate and simulate converter stages. They will also be able to understand and characterize the interaction between one or multiple converters and the grid.
Project work **5 ECTS**	Depending on the task, the project energy technology can be completed individually or in a small team. As standard, the results of the work must be documented (in brief) in writing (description of the task, project planning, documentation of the time required, summary of the results).	The project energy technology is an experimental, documentary or demonstrative scientific - practical achievement (project). This project work has a scope of 150 hours. The tasks for the project work are usually set individually. Possible tasks include: - a measurement task as part of a current research project - programming a dialogue system or a simple image processing system - conception, design and layout of a circuit, a device, etc. - construction and simulation of complex numerical models (FEM, Matlab-Simulink, etc.) and others by arrangement.
Studium Generale **varies depending on course choices, 5 ECTS in total**	Students can choose any university-wide courses.	

Sustainability Assessment I **5 ECTS**	The module provides knowledge about sustainability assessment (especially the environmental aspects) of products, processes and technologies. The methods as well as practical applications and areas of use will be explained: 1. Sustainability, Sustainable Development Goals (SDG's) and sustainability assessment. 2. Methods for assessing the different dimensions of sustainability •Procedure for conducting a life cycle assessment according to ISO 14040/44 (target and study framework, functional units, system boundaries, life cycle inventory and data collection, impact assessment (midpoint and endpoint), evaluation, scenario and sensitivity analyses) 4. Evaluation of LCA results 5. Case studies on life cycle assessments (especially with focus on plastics) •Overview of available software systems and databases 6. Life cycle assessments at the interface to Design for Recycling/Ecodesign/Circular Economy	Upon successful completion of the module, students will be able to, define and explain terms in the field of sustainability; name methods for assessing sustainability; explain how to carry out a life cycle assessment according to ISO 14040/44; define balance sheet boundaries according to requirements; analyze life cycle assessments for products and processes; define methods for Design for Recycling/Ecodesign and Circular Economy.
Sustainable Combustion **5 ECTS**	Combustion fundamentals, combustion processes of gaseous fuels, combustion calculation, flame types, laminar flame structure, turbulent combustion, combustion of liquid and solid fuels, combustion pollutants like soot, NOx, technical combustion systems, flame stability, biomass combustion. Lecture includes one or two lab experiments. The assessment is a combination of a short mid-term exam and a written final examination.	This course conveys fundamentals of combustion technology and its applications. After successfully completing the course, students will be able to : 1. differentiate between types of combustion and describe different types in detail 2. make up the balance for combustion processes, 3. explain typical examples of applications for various types of combustion, 4. identify potentials for reducing emissions and to evaluate them.

Technical Asset Management (from winter 2025/26) **5 ECTS**	Students acquire knowledge in the area of asset management methods, as well as risk mitigation and reliability analysis. Furthermore strategies for the maintenance and repair of assets - exemplarily demonstrated on components of the power supply system - are discussed, based on the condition analysis of individual systems, whereby theoretical and practical experience in the field of diagnostic methods are used. This enables the condition analysis of individual components, thus asset management strategies can be developed for a fleet management.	- Fundamentals of asset management - Investment, maintenance, reliability, lifetime costs and amortisation of systems - Maintenance and repair strategies - Fleet management - Condition diagnosis of high-voltage components based on special methods (SOT, DGA, FDS, etc.) - Heath index determination - Measures to improve condition - Life cycle management - IEC 60300 Reliability management - ISO 55000 Asset management - IEC 61025 FTA - IEC 60812 FMEA - DIN EN ISO 12100 Risk assessment and risk reduction