Power Electronic Engineering

3. Semester

Subject to Approval by the Relevant Bodies

Course	Type	THW	ECTS
Project Management	SE	2	3
Electronic Engineering Project	PT	0,5	6
Renewable Energy	LE	2	3
Power Converter Design	IC	4	6
Power Electronic Device Engineering	IC	4	6
Electric Mobility	IC	4	6
		16,5	**30**

SE Seminar

PT Project

LE Lecture

IC Integrated course

THW Hours per week

ECTS European Credit Transfer and Accumulation System

Project Management 2 SWS/3 ECTS

Teaching Content

- Project types and methodologies
- Project phases, milestones and gates
- Project plans
- Effort estimation methodologies
- Communication plans and meeting structures
- Resource-based and skill-based planning
- Risk management
- Failure mode and effect Analysis
- Agile project management

Competence Acquisition

After finishing this course, students can

- explain the nature of projects,
- compare different methods of project management,
- describe the different roles of persons involved into a project,
- create a project plan and add phases, milestones and gates of projects,
- estimate the efforts for tasks, work packages, and projects, and
- explain the risk management of a project.

Electronic Engineering Project 0,5 SWS/6 ECTS

Teaching Content

- Solving a specific technical task on the under supervision that corresponds to the level of education.

Competence Acquisition

After finishing this course, students can

- work on and solve a technical problem independently, and,
- document and present the solution.

Renewable Energy 2 SWS/3 ECTS

Teaching Content

- Transformation towards electrified systems: Overview and market situation
- Renewable Energy Generation: Photovoltaic systems, wind energy, hydropower, fuel cells, e-fuels, associated power electronic devices
- Energy Storage Systems: Hydrogen cycle, battery storage, mechanical storage, associated power electronic devices
- Smart Grids: Charging techniques, DC microgrids, operation, control, benefits

Competence Acquisition

After finishing this course, students can

- evaluate the market situation and potential for transformation towards electrified systems,
- analyse the advantages and disadvantages of various renewable energy generation methods, and explain the importance of power electronic systems in this context,
- compare and contrast different energy storage systems, including the hydrogen cycle, battery storage, and mechanical storage, and explain the importance of power electronic systems in this context, and
- evaluate smart grid systems, including charging techniques and DC microgrids, as well as their operation, and control.

Power Converter Design 4 SWS/6 ECTS

Teaching Content

- Design of non-isolated DC-DC Converters for higher density and efficiency (interleaved, multi-level)
- Selection of power semiconductors according to design criteria
- Design of DC-AC converter focusing on motor or power grid interface applications
- Design of isolated DC-DC converters including resonant converters (flyback, full-bridge, dual active bridge, series resonant converter)
- Simulation-based design of PWM control methods
- Analysis of control units in the field of power electronics

Competence Acquisition

After finishing this course, students can

- design advanced non-isolated DC-DC converters for higher density and efficiency,
- evaluate the suitability of different power semiconductors for use in power electronics applications according to design criteria,
- apply knowledge of DC-AC converters to design and implement motor and grid-tie applications,
- design isolated DC-DC converters like flyback, full-bridge, dual active bridge, and series resonant converter,
- evaluate and apply PWM control methods for power electronics applications using simulation-based techniques and
- evaluate the implications of control unit selection in power electronics systems.

Power Electronic Device Engineering 4 SWS/6 ECTS

Teaching Content

- Low voltage directive
- Analysis of protective measures and personal safety
- Analysis of typical power electronic devices e.g. PV inverters
- Simulation-based design of EMI filters including FEM electromagnetics
- Design of high current/low inductive PCBs (regarding eddy current effects)
- Analysis of mechanical assembly
- Concept and implementation of power electronic cooling systems

Competence Acquisition

After finishing this course, students can

- evaluate the effectiveness of protective measures and personal safety in the context of the low voltage directive,
- synthesize a design for an EMI filter using simulation-based techniques,
- create a high current/low inductive PCB design that considers eddy current effects,
- analyse the performance of typical power electronic devices, such as PV inverters, in terms of their electromagnetic compatibility,
- analyse the mechanical assembly of power electronic devices,
- evaluate power electronic cooling systems from their concept until their implementation, and
- synthesize knowledge and skills to design a power electronic system in a design project.

Electric Mobility 4 SWS/6 ECTS

Teaching Content

- Introduction to electric mobility: electric drivetrain, testing facilities, types, requirements
- AC electrical machines: design and construction, operating behaviour
- Universal modelling of electrical machines, including the grid as a virtual motor
- Optimized control techniques for multi-phase systems (e.g. field oriented control for electric drives)
- Analysis of test systems for electric mobility components
- Model-based design of electric mobility systems (HIL, P-HIL)

Competence Acquisition

After finishing this course, students can

- analyse the requirements and types of electric drivetrains and testing facilities for electric mobility,
- evaluate the characteristics and performance of electrical machines, including their design and construction,
- create universal models of electrical machines, incorporating the grid as a virtual motor,
- apply optimized control techniques, such as field-oriented control, to multi-phase systems,
- design testing systems for e-mobility and analyse their effectiveness, and
- design e-mobility systems using model-based approaches, such as HIL and P-HIL.