Appendix A: Course Schedule

for the study programme Electrical Engineering B.Eng.

Please note: The German version of this document is the legally binding version. The English translation provided here is for information purposes only.

Specialisation: Energy and Drive Technology

First semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1018	Occupational Fields of Electrical Engineers	BER	2	1	0	0	0	4
1071	Electrical Engineering 1	ET1	2	1	0	1	0	5
1104	Computer Science 1	INF1	2	1	0	1	0	5
1146	Mathematics 1	MA1	4	2	0	0	0	8
1195	Physics 1	PH1	2	1	0	1	0	5
1279	Materials in Electrical Engineering and Electronics	WE	2	1	0	1	0	5
							Total CP:	32
Second semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1066	Electronics 1	EL1	2	1	0	1	0	5
1075	Electrical Engineering 2	ET2	2	1	0	1	0	5
1108	Computer Science 2	INF2	2	1	0	1	0	5
1152	Mathematics 2	MA2	4	2	0	0	0	8
1200	Physics 2	PH2	2	1	0	1	0	5
							Total CP:	28
Third semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1315	Automation Technology	AT	2	1	0	1	0	5
1024	Business Administration	BW	3	1	0	0	0	5
1059	Electrical Machines	EM	2	1	0	1	0	5
1068	Electronics 2	EL2	2	1	0	1	0	5
1169	Metrology	MT	2	1	0	1	0	5
1085	Technical English 1	FSE1	0	4	0	0	0	5
							Total CP:	30
Fourth semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1013	Power Drive Technology	ATR	2	1	0	1	0	5
1051	Introduction to Electrical Power Engineering	EN	3	1	0	0	0	5
1318	Numerics for Electrical Engineers	NFE	2	1	0	1	0	5
1235	Automatic Control Engineering	RT	2	1	0	1	0	5
1242	Sensors	SEN	2	1	0	1	0	5
1121	Signals and Systems	SigSys	2	1	0	1	0	5
							Total CP:	30

Fifth semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1057	Power Generation and Distribution 1	EV1	2	1	0	1	0	5
1138	Power Electronics	LE	2	1	0	1	0	5
1078	Electric Traction	ETR	2	1	0	1	0	5
1254	Student Research Project	STA	0	0	0	2	0	5
9022	Elective Module: Energy and Drive Technology	WM				0		5
1283	Wind and Hydropower	WWK	2	2	0	0	0	5
							Total CP:	30
Sixth semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1011	Drive Systems	ATS	2	1	0	1	0	5
1058	Power Generation and Distribution 2	EV2	3	1	0	0	0	5
1193	Photovoltaics	PHV	2	1	0	1	0	5
1217	Project	PR	0	0	0	2	0	5
9022	Elective Module: Energy and Drive Technology	WM				0		5
9022	Elective Module: Energy and Drive Technology	WM				0		5
							Total CP:	30
Seventh semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1291	Bachelor Thesis	BA	0	0	0	0	0	12
1290	Colloquium	KOL	0	0	0	0	0	3
1292	Practical Project / Internship	PRA	0	0	0	0	0	15
							Total CP:	30

Abbreviations of the teaching forms: L = lecture, ST = tuition in seminars, E = exercise, S = seminar, P = practical, SSS = supervised self-study (all data in semester credit hours); CP = credit points
W/S = winter/summer semester

The practical project can optionally be replaced by a semester abroad.

Elective Modules Energy and Drive Technology									
Module number	Module title	Module ID	W/S	L	ST	E	P/S	SSS	CP
1010	Plant Design	APL	S	2	1	1	0	0	5
1042	Decentralised Energy Systems	DEZ	W	2	1	0	1	0	5
1056	Energy Storage Devices and Fuel Cells	EEB	W	2	1	0	1	0	5
3135	Gender and Diversity: Success Factors for Companies	GUD	W	2	2	0	0	0	5
1166	Measuring and Testing Systems	MPS	S	2	1	0	1	0	5
1173	Microcontrollers	MC	W	2	1	0	1	0	5

1244	Simulation Technology	SIM	W	2	1	0	1	0	5
1401	High-Voltage Technology	HST	W	2	0	1	1	0	5
1086	Technical English 2	FSE2	S	0	4	0	0	0	5
1266	Thermal Use of Renewable Energies	TNE	S	2	1	0	1	0	5
1267	Thermodynamics 1	TD1	S	2	2	0	0	0	5

EDUTech									
Module number	Module title	Module ID	W/S	L	ST	E	P/S	SSS	CP
1303	General Didactics and Orientation Practical	EDU/AD	W	0	2	0	0	0	5
1306	Vocational Education I and Vocational Field Practical	BP1	W	0	2	0	0	0	5
1307	Vocational Education II	EDU/BP2	S	0	4	0	0	0	5
1304	Diagnosis and Support	EDU/DUF	S	0	4	0	0	0	5
1312	Didactics of Technology	EDU/TD	S	0	4	0	0	0	5

Four of the five EduTech modules can be integrated into the course of study. They then replace elective modules. The fifth module is considered an additional performance.

Appendix B: Course Schedule

for the study programme Electrical Engineering B.Eng.

Specialisation: Electronics and Automation Technology

First semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1018	Occupational Fields of Electrical Engineers	BER	2	1	0	0	0	4
1071	Electrical Engineering 1	ET1	2	1	0	1	0	5
1104	Computer Science 1	INF1	2	1	0	1	0	5
1146	Mathematics 1	MA1	4	2	0	0	0	8
1195	Physics 1	PH1	2	1	0	1	0	5
1279	Materials in Electrical Engineering and Electronics	WE	2	1	0	1	0	5
							Total CP:	32
Second semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1066	Electronics 1	EL1	2	1	0	1	0	5
1075	Electrical Engineering 2	ET2	2	1	0	1	0	5
1108	Computer Science 2	INF2	2	1	0	1	0	5
1152	Mathematics 2	MA2	4	2	0	0	0	8
1200	Physics 2	PH2	2	1	0	1	0	5
							Total CP:	28
Third semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1315	Automation Technology	AT	2	1	0	1	0	5
1024	Business Administration	BW	3	1	0	0	0	5
1059	Electrical Machines	EM	2	1	0	1	0	5
1068	Electronics 2	EL2	2	1	0	1	0	5
1169	Metrology	MT	2	1	0	1	0	5
1085	Technical English 1	FSE1	0	4	0	0	0	5
							Total CP:	30
Fourth semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1013	Power Drive Technology	ATR	2	1	0	1	0	5
1051	Introduction to Electrical Power Engineering	EN	3	1	0	0	0	5
1318	Numerics for Electrical Engineers	NFE	2	1	0	1	0	5
1235	Automatic Control Engineering	RT	2	1	0	1	0	5
1242	Sensors	SEN	2	1	0	1	0	5
1121	Signals and Systems	SigSys	2	1	0	1	0	5
							Total CP:	30
Fifth semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1101	High-Frequency Electronics	HFE	2	1	0	1	0	5

1138	Power Electronics	LE	2	1	0	1	0	5
1190	Optoelectronics	OPT	2	1	0	1	0	5
1254	Student Research Project	STA	0	0	0	2	0	5
9021	Elective Module: Electronics and Automation Technology	WM				0		5
1287	State Space Control	ZRG	2	1	0	1	0	5
							Total CP:	30

Sixth semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1062	Electromagnetic Compatibility	EMC	2	1	0	1	0	5
1079	Embedded Systems	ESYS	2	1	0	1	0	5
1174	Microsystems Technology	MST	2	0	0	2	0	5
1217	Project	PR	0	0	0	2	0	5
9021	Elective Module: Electronics and Automation Technology	WM				0		5
9021	Elective Module: Electronics and Automation Technology	WM				0		5
							Total CP:	30

Seventh semester			L	ST	E	P/S	SSS	CP
Module number	Module title	Module ID						
1291	Bachelor Thesis	BA	0	0	0	0	0	12
1290	Colloquium	KOL	0	0	0	0	0	3
1292	Practical Project / Internship	PRA	0	0	0	0	0	15
							Total CP:	30

Abbreviations of the teaching forms: L = lecture, ST = tuition in seminars, E = exercise, S = seminar, P = practical, SSS = supervised self-study (all data in semester credit hours); CP = credit points
W/S = winter/summer semester

The practical project can optionally be replaced by a semester abroad.

Elective Modules Electronics and Automation Technology									
Module number	Module title	Module ID	W/S	L	ST	E	P/S	SSS	CP
1029	Machine Vision	BIL	W	2	1	0	1	0	5
3135	Gender and Diversity: Success Factors for Companies	GUD	W	2	2	0	0	0	5
1311	Intelligent Sensor Systems	ISS	S	2	1	0	1	0	5
1164	Mechatronics	ME	S	2	1	0	1	0	5
1166	Measuring and Testing Systems	MPS	S	2	1	0	1	0	5
1173	Microcontrollers	MC	W	2	1	0	1	0	5
1180	Networks and Bus Systems	NBS	W	2	2	0	0	0	5
1181	Network Technology	NW	W	2	1	0	1	0	5
1231	Computer Architectures	RA	W	2	1	0	1	0	5
1240	Robotics	ROB	W	2	1	0	1	0	5

1244	Simulation Technology	SIM	W	2	1	0	1	0	5
1401	High-Voltage Technology	HST	W	2	0	1	1	0	5
1086	Technical English 2	FSE2	S	0	4	0	0	0	5

EDUTech									
Module number	Module title	Module ID	W/ S	L	ST	E	P/S	SSS	CP
1303	General Didactics and Orientation Practical	EDU/AD	W	0	2	0	0	0	5
1306	Vocational Education I and Vocational Field Practical	BP1	W	0	2	0	0	0	5
1307	Vocational Education II	EDU/BP2	S	0	4	0	0	0	5
1304	Diagnosis and Support	EDU/DUF	S	0	4	0	0	0	5
1312	Didactics of Technology	EDU/TD	S	0	4	0	0	0	5

Four of the five EduTech modules can be integrated into the course of study. They then replace elective modules. The fifth module is considered an additional performance.

Appendix C: Module catalogue

for the study programme Electrical Engineering B.Eng.

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Vocational Education II 33
Business Administration 35
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Occupational Fields of Electrical Engineers 38
Decentralised Energy Systems 40
Diagnosis and Support 41
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Power Generation and Distribution 2 45
Energy Storage Devices and Fuel Cells 46
Electrical Machines 47
Electromagnetic Compatibility 50
Electronics 1 51
Electronics 2 53
Electrical Engineering 1 55
Electrical Engineering 2 56
Electric Traction 57
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Gender and Diversity: Success Factors for Companies 61
High-Frequency Electronics 63
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General Didactics and Orientation Practical					EDU/AD
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1303	150 h	5	3rd sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	2	SCH	30	h	30	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	80	h	10	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students

- understand didactics as a sub-discipline of education and are able to draw further boundaries to neighbouring disciplines and related disciplines as well as to identify subject areas and functions of didactics.
- are able to distinguish between selected didactic theories and models and to highlight the significance of these theoretical foundations for the planning of teaching-learning processes.
- have a basic knowledge and understanding of categories of teaching, can apply them in initial planning attempts and critically evaluate them.
- are able to transfer the steps of lesson planning and use them for their own teaching encounter in the orientation practical internship.
- are able to critically question this knowledge, to modify the resulting questions in exploratory questions and to systematically elaborate them during the orientation practical internship.
- reflect on their own developmental process and include both their first practical professional experiences and theoretical discussions of different subjects of exploration.

3 Contents:

- Genesis, subject areas/fields of activity, basic concepts and research approaches of general didactics
- Didactic theories, e.g. didactics of educational theory, learning/teaching theory didactics, constructivist didactics, didactics of educational pathways
- Structure and planning logic of teaching
- Basic forms of didactic lesson planning, implementation and analysis

4 Forms of teaching:

Tuition in seminars

5	Participation requirements:	
	Formal:	
	Content:	
6	Forms of assessment: Oral examination	
7	Prerequisite for the award of credit points: Module examination pass and course assessment	
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng. and Mechanical Engineering B.Eng.	
9	Importance of the grade for the final grade: according to BRPO	
10	Module coordinator: Prof. Dr.-Ing. Thorsten Jungmann	
11	Other information:	
12	Language: German	

Plant Design					APL
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1010	150 h	5	4th or 6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22	h
	Exercise	20 students	1	SCH	15	h	23	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: After successful completion of the module Plant Design, the students are able to systematically evaluate a planning task in low voltage and medium/high voltage and to critically question the solution. This includes the structuring of the planning task and the analysis of the task. The students can defend the solutions.
3	Contents: Systematic approach to plant planning and design. Design, dimensioning and assessment of energy production plants using the example of biogas plants. Planning and projecting of electrical energy systems and electrical energy generation systems, especially regenerative energy generation systems. Current aspects of new construction and the expansion planning of electrical power supply systems.
4	Forms of teaching: Lecture and seminar
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng., Renewable Energies B.Eng. and Industrial Engineering and Management B.Sc.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Jens Haubrock
11	Other information: Literature will be announced at the beginning of the course. Renewable Energies study programme, specialisation in Energy Efficient Systems: Elective subject
12	Language: German

Drive Systems					ATS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1011	150 h	5	6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The participant in the module will be qualified:

- to assess and select electric four-quadrant drives with regard to control structure, dynamics and control range
- to understand methods of modern control theories in the state space and apply them advantageously in drive practice
- to design observer-oriented control methods for sensorless low-cost automation and redundant safety applications
- to learn about unconventional methods such as fuzzy control

3 Contents:

- Optimum run-up, reversing operation, four-quadrant operation, multi-motor drives
- Model-based drive controls in the state space (time domain)
- Sensorless drive controls (observers replace sensors)
- Space vector representation in three-phase systems
- Field-oriented control of the three-phase asynchronous machine
- Methods of fuzzy control and their application in drives

Lab practicals:

1. Four-quadrant DC drive with 4Q chopper actuator
2. Voltage-frequency control of the three-phase asynchronous machine
3. Field-oriented control of a 4Q frequency inverter drive

4 Forms of teaching:

Lecture, seminar-based teaching and laboratory exercises in small groups (3–4 participants)

5 Participation requirements:

Formal:	None
Content:	Modules Electrical Machines (1059), Drive Systems (1013) and Power Electronics (1138) should be successfully completed

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. Ing. habil. Klaus Hofer

11	Other information: Literature will be announced at the beginning of the course. Students must have sufficient knowledge and experience in the use and safety of electrical equipment.
12	Language: German

Power Drive Technology					ATR
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1013	150 h	5	4th or 6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students will be able to

- completely select converter-fed drives for any practical application and describe them in terms of control technology
- determine the optimal controller parameters of a cascade structure in the frequency domain
- carry out the technical realisation with operational amplifiers (analogue) or microcontrollers (digital)

3 Contents:

- Mechanical and dynamic requirements on the shaft (four-quadrant operation)
- Project planning and dimensioning of controlled electric drives
- Selection of suitable machine - converter combinations
- Position-speed-torque cascade structure and its control-technical description (Laplace transform)
- Determination of the controller parameters with the help of the frequency characteristics in the Bode diagram and their analogue and digital realisation
- Fields of application of electrical drive technology

4 Forms of teaching:

Lecture, seminar-based teaching and laboratory exercises in small groups (3–4 participants)

5 Participation requirements:

Formal:	None
Content:	Module on Electrical Machines (1059) should have been successfully completed

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. Ing. habil. Klaus Hofer

11 Other information:

Literature will be announced at the beginning of the course.
Students must have sufficient knowledge and experience in the use and safety of electrical equipment.

	Study programme Renewable Energies, specialisation Energy Generation Systems: Elective subject
12	Language: German

Automation Technology					AT
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1315	150 h	5	3rd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students learn the basic difference between the chain of effects and the circle of effects for value-continuous and value-discrete signals. Building on the fundamentals of systems theory, skills for the design and implementation of discrete-event controls as well as basic knowledge of the observation and diagnosis of discrete-event systems are taught.

3 Contents:

- Basic concepts of automation technology and systems theory
- Description of discrete-event systems by deterministic and non-deterministic autonomous automata, standard automata, in/output automatons and Petri nets.
- Behaviour of deterministic and non-deterministic autonomous automata, standard automata, input/output automata and Petri nets.
- Heuristic control design and implementation of the control law by means of application list (AWL) and step chains.
- Systematic design of discrete-event controllers based on a model of the control path
- Observation and diagnosis of discrete-event systems

4 Forms of teaching:

Lecture with accompanying seminar exercises and practicals

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Weidemann

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Bachelor Thesis					BA
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1291	360 h	12	6th or 7th semester	each semester	12 weeks

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	360	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	With the bachelor thesis, each candidate demonstrates that he/she is able to complete a practice-oriented task from his/her subject area within a specified period of time, both in its subject-specific details and in the interdisciplinary contexts, working independently and according to scientific methods.	
3	Contents:	
	The bachelor thesis is usually an independent investigation with an engineering science or engineering technology task. It should deal with the subject matter in detailed descriptions and explanations and be prepared as a written paper.	
4	Forms of teaching:	
5	Participation requirements:	
	Formal:	None
	Content:	Coordinated topic from the student's special subject area
6	Forms of assessment:	
7	Prerequisite for the award of credit points:	
8	Application of the module (in the following study programmes)	
	Apparative Biotechnology B.Sc., Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng, Mechanical Engineering B.Eng., Mechatronics B.Sc., Renewable Energies B.Eng. and Industrial Engineering and Management B.Sc.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Anton Klar	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Vocational Education I and Vocational Field Practical					BP1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1306	150 h	5	3rd or 5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	2	SCH	30	h	30	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	80	h	10	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students:

- understand vocational education as a sub-discipline of educational science, are able to distinguish the respective subject areas and research fields from each other and explain them in context.
- systematically reflect on exemplary practical experiences in the workplace and thereby also examine motives for their own career path.
- are able to identify requirements for company and school educators and in this context understand vocational education as a profession.
- can describe the structures, forms and interfaces of the vocational education and training system in Germany in a differentiated manner and consider the historical, educational policy and legal framework conditions.
- use tools of scientific work competently.

3 Contents:

- Concepts, subject areas and research fields of educational science and vocational education as a sub-discipline of educational science,
- Objectives, structures and interfaces of the Vocational Educational Training (VET) system, legal framework of VET,
- Contributors and roles in the VET system,
- Processes of (vocational) pedagogical professionalisation
- Software tools: Word processing programme, literature management programme
- Methods of scientific work: Research, source work, text production

4 Forms of teaching:

Tuition in seminars

5 Participation requirements:

Formal:	
Content:	

6 Forms of assessment:

Oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Mechanical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10	Module coordinator: Prof. Dr.-Ing. Thorsten Jungmann
11	Other information:
12	Language: German

Vocational Education II					EDU/BP2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1307	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	4	SCH	60	h	90	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students:

- are able to derive vocational education issues or problems and to deal with them in a systematic and theoretically sound manner, taking into account existing criteria of scientific work,
- can plan and prepare vocational training, apply training methods and design the completion of training,
- are able to describe the process of developing a teaching-learning scenario,
- interpret and didactically transform a selected learning field based on the framework curriculum of a training occupation.
- recognise interfaces to general and subject-related didactics in the context of Vocational Educational Training (VET) research and empirical classroom research.
- can critically reflect and classify current research trends in VET research on the basis of their level of knowledge. In this context, they discover possible research desiderata in their own profession-specific field,

3 Contents:

- Scientific work: Plan, structure, write and prepare texts for publication,
- Research objects, research questions and research methods in education and training or vocational education and training research,
- Concept of practice or action research to explore own teaching,
- Learning field and competence-oriented design of lessons,
- Action-oriented methods for training, instruction and teaching,
- Training regulations, training plan and examination

4 Forms of teaching:

Tuition in seminars

5 Participation requirements:

Formal:	
Content:	

6 Forms of assessment:

Term paper

7 Prerequisite for the award of credit points:

Module examination pass

8	Application of the module (in the following study programmes) Electrical Engineering B.Eng. and Mechanical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Thorsten Jungmann
11	Other information:
12	Language: German

Business Administration					BW
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1024	150 h	5	3rd or 5th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	3	SCH	45	h	67.5	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students know the basic organisational and legal structures of companies and are familiar with the optimisation tasks in selected entrepreneurial functional areas as well as with the basic principles and success criteria of economic action in order to be able to classify their engineering activities in a business management context and to evaluate the economic consequences of their activities. The students master methods and tools for problem solving in selected corporate functional areas. They can apply business management instruments and calculation methods in a target-oriented manner and assess their effects.

3 Contents:

- Basic concepts of business administration / basic principles of economic action
- Overview of the entrepreneurial functional areas of the goods economy, financial economy and information economy level
- Corporate goals and corporate key figures / key figure systems
- Basic concepts of private and commercial law
- Forms of corporate law

4 Forms of teaching:

Lecture, seminar-based teaching with case studies / case studies / exercises

5 Participation requirements:

Formal:	
Content:	

6 Forms of assessment:

Written examination, combination examination, performance examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng., Mechanical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. rer. pol. Hildegard Manz-Schumacher

11 Other information:

Literature will be announced at the beginning of the course.

12	Language: German

Machine Vision					BIL
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1029	150 h	5	5th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: Name and explain the basic concepts, elementary connections and laws of machine vision. Demonstrate and apply the basic descriptive tools and analytical methods of machine vision. Name the current areas of application. Understand and interpret the practical significance of machine vision. Capable of developing independent solutions in simple application areas of machine vision.
3	Contents: Historical overview and current developments in machine vision, sensor systems for image data acquisition, basics of technical optics for the acquisition of scenes, illumination and object positioning, programming systems, handling machine vision programmes, LUT and grey value programming, contour analysis and edge detection, filters in the spatial and frequency range, morphology, template matching, colour image processing, applications of machine vision as a quality assurance tool, biotechnological and medical applications, design of machine vision systems, machine vision software, design of vision systems for process monitoring.
4	Forms of teaching: Lecture, practicals and exercises
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination, combination examination, performance examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes) Apparative Biotechnology B.Sc., Electrical Engineering B.Eng., Mechatronics B.Sc. and Industrial Engineering and Management B.Sc.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Reinhard Kaschuba
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Occupational Fields of Electrical Engineers					BER
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1018	120 h	4	1st sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	50	h
	Tuition in seminars	30 students	1	SCH	15	h	25	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

After completing the module, students will be able to:

- Outline the historical development of engineering as a profession and relate relevant areas of the company to each other
- Critically compare the different training and career opportunities in engineering
- Identify the basic concepts of the market as well as the different forms of organisation of a company
- Relate the individual departments to the development of a consumer or investment good and describe the individual interfaces
- Comment on group dynamic processes and different characteristics of personalities in individual occupational fields

3 Contents:

- Emergence of the engineering profession
- Training for Bachelor or Master of Engineering
- Engineers in modern industrial companies, business units
- Market, purchasing power, supply and demand, goods, needs
- Sectors and main activities of the engineer
- Direct comparison of fields of activity: Industrial enterprises and public service
- Salary structures and career opportunities
- Team compositions, roles and personalities in the professional field
- Soft skills in engineering

4 Forms of teaching:

Lecture and seminar-based teaching with project and group work, if necessary business simulation game or excursions.

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Course assessment

7 Prerequisite for the award of credit points:

Course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO or SPO if ungraded elective subject

10 Module coordinator:

	Dipl.-Ing. Vanessa Prott-Warner
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Decentralised Energy Systems					DEC
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1042	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: Students understand the technical structure and economic function of energy supply systems. They are familiar with combined heat and power (CHP) technology plants and can calculate, evaluate and analyse the processes. They are familiar with the basic interrelationships for modelling decentralised energy systems and can assess the reliability of energy supply systems.
3	Contents: Structure and function of the German energy market (power exchange). Design and structure of centralised / decentralised energy supply systems. Working machines for combined heat and power generation. Reliability and availability of electrical energy supply systems
4	Forms of teaching: Lecture, seminar-based teaching with exercises and practical course
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written or oral examination; in each case with preliminary examination performance
7	Prerequisite for the award of credit points: Module examination pass with preliminary examination
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng. and Renewable Energies B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Jens Haubrock
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Diagnosis and Support					EDU/DUF
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1304	150 h	5	4th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	4	SCH	60	h	90	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self--study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students...

- can explain selected learning theories and distinguish them from each other. In addition, they are able to point out application references from the different theories in a well-founded manner.
- have diagnostic competence and apply it in the context of pedagogical action, taking empirical findings into account.
- are able to demonstrate the significance of competence orientation for the vocational education system and to assess its consequences, especially for the design of competence-oriented examinations.
- know teaching features relevant to learning and can reflect on their significance against the background of their own learning biographical experiences. They are able to design effective learning environments, plan and conduct appropriate forms of assessment.
- have a critical understanding of the aspects of diversity and heterogeneity in learning groups and, in this context, have basic knowledge of the individual support of learners and their learning processes.

3 Contents:

- Cognitive development and personality development,
- Learning theories and motivation,
- Teaching and performance measurement,
- Competence orientation, competence-oriented examinations,
- Individuality and heterogeneity in learning groups, individual support,
- Professional teaching perception,
- Research methodological basics on observation, observation and assessment tools, observation and assessment errors.

4 Forms of teaching:

Tuition in seminars

5 Participation requirements:

Formal:	
Content:	

6 Forms of assessment:

Oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Mechanical Engineering B.Eng.

9 Importance of the grade for the final grade:

	according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Thorsten Jungmann
11	Other information:
12	Language: German

Introduction to Electrical Power Engineering					EN
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1051	150 h	5	4th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	3	SCH	45	h	67.5	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: After completing the module, students will be able to: - explain the key figures of the electrical energy supply - explain and compare electrical networks for the supply of electrical energy - explain electrical power supply equipment - find out the economic efficiency of the energy supply
3	Contents: Key figures of the electric power supply. Operating resources. Symmetrical components. Three-pole short circuits. Transformers and voltage maintenance. Power factor correction. Load curves, load level. Production costs
4	Forms of teaching: Lectures and exercises
5	Participation requirements:
	Formal: None
	Content: Calculation of matrices, 1st order differential equations. Basic layers Electrical engineering
6	Forms of assessment: Written examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Jürgen Schlabbach
11	Other information: Literature will be announced at the beginning of the course. Schlabbach:.: Elektroenergieversorgung:.: 3. Auflage:.: VDE-Verlag Große-Gehling, Just, Reese, Schlabbach:.: Blindleistungskompensation:.:VDE-Verlag
12	Language: German

Power Generation and Distribution 1					EV1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1057	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

After completing the module, students can
- explain and design operating equipment for electrical power supply
- name classical types of star point treatment and compare them critically
- classify grid control procedures
- use standards and regulations

3 Contents:

Basic information on the design of equipment.
Equivalent circuits in the zero system.
Symm. and asymm. circuits. Short-circuit currents.
Surge short-circuit currents.
Types of neutral point treatment and design.
Generator regulation.
Interconnected operation.
Grid regulation.
Standards and regulations

4 Forms of teaching:

Lectures and exercises or term papers or seminar presentation

5 Participation requirements:

Formal:	None
Content:	Electrical machines (1059)

6 Forms of assessment:

Written examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Jürgen Schlabbach

11 Other information:

Literature will be announced at the beginning of the course.
Schlabbach:.: Elektroenergieversorgung:.: 3. Auflage:.: VDE-Verlag
Schlabbach:.: Sternpunktbehandlung:.: VWEW-Energieverlag
Schlabbach:.: Kurzschlussstromberechnung:.: VWEW-Energieverlag

12 Language:

German

Power Generation and Distribution 2					EV2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1058	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	3	SCH	45	h	67.5	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	Dimensioning of plants, equipment and grids, evaluation of the grid connection of generation plants, grid reactions	
3	Contents:	
	Thermal and electromagnetic effects of short-circuit currents. Voltage quality. Mains feedback. Grid connection conditions for wind, photovoltaic systems, etc. Grid stability. HVDC systems. Thermal load capacity of cables, overhead lines and transformers. Structure of switchgear	
4	Forms of teaching:	
	Lectures and exercises or term papers or seminar presentation	
5	Participation requirements:	
	Formal:	None
	Content:	Power Generation and Distribution 1 (1057), Power Electronics (1138)
6	Forms of assessment:	
	Written examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes)	
	Electrical Engineering B.Eng.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Jürgen Schlabbach	
11	Other information:	
	Literature will be announced at the beginning of the course. Schlabbach:.: Elektroenergieversorgung:.: 3. Auflage:.: VDE-Verlag Just, Hormann, Schlabbach:.: Netzrückwirkungen:.: VWEW-Energieverlag Metz, Schlabbach:.: Netzsystemtechnik:.: VDE-Verlag	
12	Language:	
	German	

Energy Storage Devices and Fuel Cells					EEB
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1056	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: The students are familiar with different energy storage technologies. They can classify them and understand the difference between power storage and energy storage. They know the technical basics of storage and retrieval and the structure of storage systems. Students in this module are able to design and optimally dimension a possible energy storage system for a specific task. They are familiar with the fundamentals of simulation and modelling of energy storage systems.
3	Contents: Physical basics of selected storage technologies (e.g. accumulators, double-layer capacitors, flywheel mass, pumped storage, superconducting magnetic energy storage). Classification of storage according to power and energy storage. Application examples of storage systems, optimal design and dimensioning of storage systems. Fuel cell systems, structure and classification of selected technologies.
4	Forms of teaching: Lecture, seminar-based teaching with exercises and practical course
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written or oral examination; in each case with preliminary examination performance
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng. and Renewable Energies B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Jens Haubrock
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Electrical Machines					EM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1059	150 h	5	3rd or 5th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students will be able to

- understand the mathematical description and the magnetic properties as well as the equivalent circuit diagrams, pointer diagrams and locus curves of electrical machines and transformers
- carry out the design of electrical machines for more complex drive systems
- recognise the steady-state and dynamic relationships between the electrical, chemical, magnetic and mechanical quantities

3 Contents:

- Motor and generator properties of electrical machines
- Direct current machines, transformers, three-phase machines, linear motors
- Modern control and regulation methods for electrical machines
- Small and special motors for precision engineering and information technology

Laboratory exercises:

- Measurement of the characteristics of a DC machine
- Short-circuit and no-load measurement of a transformer
- Measurement of the characteristics of a three-phase asynchronous machine

4 Forms of teaching:

Lecture, seminar-based teaching and laboratory exercises in small groups (3–4 participants)

5 Participation requirements:

Formal:	None
Content:	The basics of electrical engineering should have been successfully completed

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. Ing. habil. Klaus Hofer

11 Other information:

Literature will be announced at the beginning of the course.
Students must have sufficient knowledge and experience in the use

	and safety of electrical equipment
12	Language: German

Electromagnetic Compatibility					EMC
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1062	150 h	5	6th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students know the basic coupling types and the underlying physical laws. They have an overview of the typical protective measures. They know the measuring equipment required for EMC tests and the technical background of the tests. They are familiar with the guidelines and standards to be complied with.

3 Contents:

- Principles
- Coupling modes and Maxwell's equations
- Shielding and filter
- Legal requirements
- Measurement methods, theoretical and practical

4 Forms of teaching:

Lecture, seminar-based teaching and practical course

5 Participation requirements:

Formal:	None
Content:	Metrology (1169)

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Thomas Westerwalbesloh

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Electronics 1					EL1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1066	150 h	5	2nd sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Knowledge of the physical properties and effects, characteristic data, characteristic curves, model description and possible applications of discrete diode and transistor types
- Electronic circuit dimensioning skills
- Skills in building and troubleshooting electronic circuits
- Knowledge of basic circuits of discrete electronics

3 Contents:

Diodes:

- Parameters, diode types, models, characteristic curves and data sheets
- Rectifier circuits
- Voltage stabiliser with Z-diode
- Voltage multiplier

Bipolar transistor:

- Structure, mode of operation, types, characteristic curves, model parameters and data sheets
- Voltage stabilisation and constant current source with bipolar transistor
- Operating point stabilisation and AC voltage amplifier Field effect transistor:
- Structure, mode of operation, types, characteristic curves, model parameters and data sheets
- DC and AC voltage applications

Application of transistors as switches in switching power supplies

4 Forms of teaching:

Lecture, seminar, practical course

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Zielke

11 Other information:

Literature will be announced at the beginning of the course.

12	Language: German

Electronics 2					EL2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1068	150 h	5	3rd sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Skills in the application of analogue circuit techniques and the competency to use analogue integrated circuits
- Knowledge of digital logic elements and their interconnection to complex digital circuits
- Ability to independently design and optimise electronic circuits
- Competence to independently understand the function of circuit designs

Skills for calculating and optimising electronic switching by means of circuit simulation

3 Contents:

Analogue Integrated Circuit Technology:

- Operational amplifier (OPV) types, structure and parameters Basic OPV circuits
- Non-linear and complex feedback OPV circuits
- Active higher order filters
- Signal generators
- Circuit simulation using PSPICE

Digital integrated circuit technology:

- Basic building blocks of digital technology
- Circuit families and their parameters
- Switching networks
- Rear derailleurs

4 Forms of teaching:

Lecture, seminar, practical course

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Zielke

11 Other information:

	Literature will be announced at the beginning of the course.
12	Language: German

Electrical Engineering 1					ET1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1071	150 h	5	1st sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

After completing the module, students will be able to:

- name the basic electrotechnical parameters
- name and apply the different calculation methods of linear DC networks
- describe and mathematically analyse electric flow fields and electrostatic fields with the respective parameters

3 Contents:

- Basic physical terms in electrical engineering
- Conduction mechanisms
- Linear direct current networks and their calculation methods
- The steady-state electric flow field
- The electrostatic field / the capacitor
- Three laboratory practicals in small groups

4 Forms of teaching:

Lecture, seminar-based teaching, laboratory practicals

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Rüdiger Schultheis

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Electrical Engineering 2					ET2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1075	150 h	5	2nd sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: After completing the module, students will be able to: – name parameters of the magnetic field as well as describe and mathematically analyse magnetic fields with basic methods understand linear alternating current circuits and analyse them with the aid of complex calculation.
3	Contents: The static magnetic field The time-varying magnetic field The first two Maxwell's equations, the flow law, the induction law/inductance Alternating current theory: Parameters. Application of complex calculation If necessary. Multiphase systems
4	Forms of teaching: Lecture, seminar-based teaching, laboratory practicals
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination; each with preliminary examination
7	Prerequisite for the award of credit points: Module examination pass with preliminary examination
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Rüdiger Schultheis
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Electric Traction						ETR
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer		Duration:
1078	150 h	5	4th or 6th semester	Annual (Summer)		1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students will be enabled to:

- learn and understand the design of electric vehicles with rotary and linear drive systems
- realistically assess the problems of storing electrical energy

adopt the enormous advantages and future prospects of electric road vehicles and apply them in a useful way

3 Contents:

- Traction characteristics (road grip) of electric road and rail vehicles (multi-motor drives) in comparison to vehicles with combustion drive systems
- Ecological consumption formula for the energy demand of different means of transport in SI units and the definition of environmentally friendly mobility
- Energy storage on mobile vehicles (electrochemical and mechanical storage)
- Alternative solutions with hybrid drives, fuel cells, ultracaps and regenerative energy sources (solar vehicles)
- Useful tips for energy-saving driving style
- Practical applications (ICE, Transrapid, e-car, e-bike, e-unicycle)

4 Forms of teaching:

Lecture, seminar-based teaching and laboratory exercises in small groups (3–4 participants)

5 Participation requirements:

Formal:	None
Content:	Modules on Electrical Machines (1059) and Power Electrics (1138) should have been successfully completed

6 Forms of assessment:

Written examination, combination examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. Ing. habil. Klaus Hofer

11 Other information:

Literature will be announced at the beginning of the course.

	Students must have sufficient knowledge and experience in the use and safety of electrical equipment
12	Language: German

Embedded Systems					ESYS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1079	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students:

- name and explain the different hardware concepts on which common embedded systems are based.
- explain the underlying hardware technologies, name advantages and disadvantages and evaluate the applicability for various practical problems.
- implement combinatorial and sequential function blocks in a synthesis language (e.g. VHDL) and use common toolchains to bring the synthesised functions to a target hardware (e.g. FPGA).
- develop a complex logic component according to specifications based on the previously developed function modules.
- evaluate algorithms with regard to their implementability in hardware or software (hardware/software co-design).
- explain design concepts for the hardware-related processing of discrete and continuous signals.
- distinguish the parallel design of algorithms for the hardware synthesis from conventional programming.
- compare their synthesis results with those of the other students and discuss differences in small groups.

3 Contents:

- Introduction to the topic of embedded systems (reactive, transforming systems, etc.)
- Classification of embedded hardware (microcontrollers, microprocessors, FPGAs, SoCs, etc.)
- Hardware technologies for the implementation of digital logic (SPLDs, CPLDs, FPGAs, ASICs)
- Repetition of combinatorial and sequential logic (pipelining etc.)
- Concepts of reliability, efficiency, hard and soft real time
- Hardware description languages (synthesis languages such as VHDL, VERILOG) compared to programming languages
- Introduction to VHDL
- Implementation of combinatorial and sequential logic components such as adders, multiplexers, automata, etc. in VHDL and their synthesis for an FPGA
- Synchronisation of the communication of asynchronous systems (one-synchronisation, metastability)
- Implementation of simple bus systems
- Aspects of hardware/software co-design

	- Control of mechatronic systems such as robots	
4	Forms of teaching:	
	Lecture, seminar-based teaching, practical course	
5	Participation requirements:	
	Formal:	None
	Content:	Basic knowledge in the fields of digital technology, programming and computer architectures Modules: 1045 Digital Electronics II; 1070 Digital Electronics I; 1104 Computer Science 1
6	Forms of assessment:	
	Written examination, combination examination or oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes)	
	Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng, Mechatronics B.Sc. and Industrial Engineering and Management B.Sc.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr. rer. nat. Axel Schneider	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Gender and Diversity: Success Factors for Companies					GUD
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
3135	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	2	SCH	30	h	45	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students ..

- know the terms, history and differences of gender/ gender mainstreaming and diversity/ diversity management.
- know legal principles in the context of gender and diversity (e.g. EU Anti-Discrimination Directive, General Equal Treatment Act)
- are sensitised to human heterogeneity in the corporate context.
- independently recognise stereotyping and can develop ideas for possible changes in the business environment.
- are able to independently collect relevant information on established concepts such as gender mainstreaming and diversity management and to assess their relevance for professional practice.
- are familiar with selected theories and approaches in the current discourse on diversity management and, building on this, are able to develop conceptual ideas for the implementation of holistic diversity management in a corporate context.

3 Contents:

- Definitions and delimitation of gender and diversity Concepts and approaches to equal opportunities (e.g. diversity management, gender mainstreaming)
- Legal bases and political influences (e.g. EU Anti-Discrimination Directive). General Equal Treatment Act (*German* abbreviation: AGG))
- Subjective and social values, attitudes and prejudices in the context of diversity
- Possible approaches for taking diversity characteristics (e.g. gender and age) into account in selected areas of business (marketing, product development, human resources)
- Concept for the sustainable introduction of holistic diversity management
- Case studies and application examples from business practice

4 Forms of teaching:

Lecture, seminar-based teaching, presentation, group work, presentation of seminar paper

5 Participation requirements:

Formal:	
Content:	None

6 Forms of assessment:

	Term paper, written examination, project work or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Applied Mathematics B.Sc., Apparative Biotechnology B.Sc., Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng., Mechanical Engineering B.Eng., Mechatronics B.Sc., Renewable Energies B.Eng. and Industrial Engineering and Management B.Sc.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Andrea Kaimann
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

High-Frequency Electronics					HFE
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1101	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

After completing the module, students will be able to:

- name, calculate and understand all common four-pole parametres for the description of linear components in AC and high-frequency technology,
- select and apply the measurement technique for determining four-pole parameters and evaluate the measurement results produced,
- explain the state of wave matching of linear high-frequency systems and design the necessary system boundary conditions,
- explain components of high-frequency electronics and select them for the specific application

3 Contents:

- Four-pole theory for the description of linear circuits
- Theory of lines
- wave matching
- Scattering parameters
- The Smith Chart
- Components of high-frequency electronics
- Laboratory practicals in small groups

4 Forms of teaching:

Lecture, seminar-based teaching, laboratory practicals in small groups.

5 Participation requirements:

Formal:	None
Content:	Mathematics 1 (1146 or 1147) and 2 (1152 or 1153). Electrical Engineering 1 (1071 or 1072) and 2 (1075)

6 Forms of assessment:

Written or oral examination; in each case with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Mechatronics B.Sc.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Rüdiger Schultheis

11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Computer Science 1					INF1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1104	150 h	5	1st sem.	Annual (Winter)	1 sem.

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students name the contents of the basics of computer science and can explain them.
- In particular, they are able to apply the methods of structured programming to practice-oriented smaller problems.
- They can safely use functions from the C standard library, e.g. for reading and writing files.
- Students use the tools of an integrated development environment with editor, compiler, linker and debugger to design and create simple structured programmes in C++.

At the end of the semester, they design, realise and test a self-imposed development task in C++ in partner work under the specification of boundary conditions, inform themselves independently in the tutorial and on the internet about alternative solutions, present the results in a short lecture and evaluate the results of their fellow students to some extent.

3 Contents:

- Basic structure, function and mode of operation (binary number operations) of a digital computer,
- Basics of programming in C++,
- Intensive use of the tools of an integrated development environment,
- Simple and complex data types,
- Modularisation of programmes,
- Elementary examples of simple and complex data structures and algorithms,

Discussion, analysis and practical programming of numerous examples.

4 Forms of teaching:

Lecture, seminar-based teaching, project and group work within the framework of the internship

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written or oral examination; in each case with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

	according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Lutz Grünwoldt
11	Other information: Literature will be announced at the beginning of the course. Script will be provided.
12	Language: German

Computer Science 2					INF2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1108	150 h	5	2nd sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students have basic knowledge of the methods of object-oriented programming (OOP).
- The students explain the essential principles and terms of object-oriented programming and have the ability to apply these confidently to practice-oriented problems.

At the end of the semester, the students develop and programme a thematically self-selected application with a graphical user interface using C# in partner work and present it within the framework of the practical course. They discuss and evaluate the solutions of their fellow students.

3 Contents:

- Concepts of object-oriented programming (OOP) and their implementation using C#,
- Discussion of numerous elementary examples from technology and mathematics,
- Intensive use of the tools of an integrated development environment,
- Building elementary class relationships and hierarchies,
- Object-oriented error handling and treatment of advanced OOP topics (e.g. generic Container),

Introduction to programming of graphical user interfaces (event-oriented programming, e.g. with C#)

4 Forms of teaching:

Lecture, seminar-based teaching, project and group work within the framework of the internship

5 Participation requirements:

Formal:	None
Content:	Knowledge of the basics of programming Modules: 1104 Computer Science 1

6 Forms of assessment:

Written or oral examination; in each case with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Lutz Grünwoldt

11	Other information: Literature will be announced at the beginning of the course. A script will be provided.
12	Language: German

Intelligent Sensor Systems					ISS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1311	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

In relation to the contents listed below, the students can classify and assess sensors as essential components of mechatronic systems. They can select and configure sensors suitable for mechatronic production processes in a targeted manner, and design and develop sensors relevant for mechatronic products. They confidently apply the necessary means and methods of describing sensor systems as an essential step in overall system design. The students use the basic knowledge of signal processing in the field of sensor technology to design intelligent sensor systems. They analyse trends and current fields of application in the area of modern sensor technology and the associated development methodology.

3 Contents:

Sensors:
Definition of terms, categorisation according to transducer technologies, categorisation according to applications, sensor characterisation (accuracy, resolution, sensitivity, linearity)
Sensor signal chain:
Signal processing and conditioning, design and realisation of analogue filters, ADU/DAU, sampling theorem
Sensor signal processing:
Sensor error correction, discrete-time processing of analogue signals, spectral analysis/FFT, windowing, design and implementation of digital filters
Construction of technical sensor systems:
Integration levels, intelligent sensors, indirect/virtual sensors, aspects of embedded systems (mC, DSP, FPGA), connectivity/network connection
Development methodology and applications

4 Forms of teaching:

Lecture, seminar-based teaching with computer exercises, practical course

5 Participation requirements:

Formal:	
Content:	Electrical Engineering (1073 and 1076 Mechatronics. 1070 Engineering Computer Sciences, 1070 Industrial Engineering and Management), Electronics (1063 Mechatronics. 1067 and 1069 Engineering Computer Sciences, 1065 Industrial Engineering and Management), Electrical Engineering 2

6 Forms of assessment:

Written examination, combination examination, performance examination or oral examination

7 Prerequisite for the award of credit points:

	Module examination pass and course assessment
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng, Mechatronics B.Sc. and Industrial Engineering and Management B.Sc.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Joachim Waßmuth
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Colloquium					KOL
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1290	90 h	3	6th or 7th semester	each semester	

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	90	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	The colloquium is to be assessed as an independent examination. It serves to determine whether the candidate is capable of orally presenting and independently justifying the scientific topic of the bachelor thesis, its subject-related foundations, its interdisciplinary connections and its non-subject-related references, as well as its significance for practical applications.	
3	Contents:	
	- Content of the thesis according to the topic - Disputation on the procedure in the preparation of the thesis and the questions that arose in the context of the thesis	
4	Forms of teaching:	
	Oral examination for the bachelor thesis	
5	Participation requirements:	
	Formal:	None
	Content:	Treatment of the bachelor thesis
6	Forms of assessment:	
	Oral examination	
7	Prerequisite for the award of credit points:	
8	Application of the module (in the following study programmes)	
	Applied Mathematics B.Sc., Apparative Biotechnology B.Sc., Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng., Mechanical Engineering B.Eng., Mechatronics B.Sc., Renewable Energies B.Eng. and Industrial Engineering and Management B.Sc.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Rüdiger Schultheis	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Power Electronics					LE
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1138	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students will be able to

- understand power electronic components in their function and diversity, from simple dimmers in lighting and household appliances to three-phase frequency converters in three-phase applications
- acquire knowledge of electromagnetic compatibility (EMC) for the interference-free interaction of micro- and power electronics
- establish power balances with regard to the harmonics

3 Contents:

- Functional principle of commutationless, line-commutated and self-commutated converter circuits (W1, W3, B2, B6)
- Rectifier, inverter, converter and four-quadrant operation
- Efficiencies, harmonics (Fourier), power calculations
- Control, protection and cooling of power electronic components
- Three-phase drives with IGBT frequency converter (space vector modulation)
- Mains-friendly power converters with Power Factor Control (PFC)
- Monolithic fusion of power electronics (energy) and microelectronics (information) on one semiconductor chip (power chips)
- Innovative fields of application of power electronics in automation technology, in electric vehicles and in decentralised energy management

Laboratory practicals:

1. Commutationless converter circuit
2. Line-commutated power converter circuit
3. Self-commutated converter circuit

4 Forms of teaching:

Lecture, seminar-based teaching and practical training in small groups (3 - 4 participants)

5 Participation requirements:

Formal:	None
Content:	Modules on Electrical Machines (1059) and Drive Technology (1013) should be successfully completed

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

	according to BRPO
10	Module coordinator: Prof. Dr. Ing. habil. Klaus Hofer
11	Other information: Literature will be announced at the beginning of the course. Students must have sufficient knowledge and experience in the use and safety of electrical equipment. Renewable Energies study programme, specialisation in Energy Efficient Systems: Elective subject
12	Language: German

Mathematics 1					MA1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1146	240 h	8	1st sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	4	SCH	60	h	100	h
	Tuition in seminars	30 students	2	SCH	30	h	50	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students:

- use scientific notation
- know the concept of function and what is meant by variable, domain, range, rate of change for linear, quadratic, logarithmic, exponential and other function
- name the elementary functions, their properties and are able to outline them
- work with exponents, polynomials and rational expressions
- solve equations (quadratic equations) and inequalities
- graph linear and non-linear equation
- solve algebraic equations containing complex fractions
- calculate integrals and are able to calculate areas and lines,
- know the basics of linear algebra
- represent straight lines and planes in vectorial form and know the different algebraic forms of representation

solve linear equations systems by Gaussian elimination method

3 Contents:

- Stets, subsets, operation on stets (number and quantity)
- Domain and range of functions
- Sequences and series (arithmetic series, geometric series)
- Elementary functions (linear, quadratic, polynomials, rational, logarithmic, exponential and trigonometric functions) and illustrations or functions
- Continuity and differentiability of functions in one variable
- Solving equations and inequalities
- Complex numbers (Euler's formula and polar representation of complex numbers)
- Riemann integral, partial integration and substitution formula
- Basics of linear algebra
- Vectors, vector spaces, bases and dimension, scalar product, vector product
- Matrices, determinant, matrix representation of linear maps
- Linear equations systems, Gaussian elimination method

4 Forms of teaching:

Lecture, seminar

5 Participation requirements:

Formal:	None
Content:	Good basic mathematical knowledge at German 'Fachoberschulniveau' level

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Martin Kohlhase
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Mathematics 2					MA2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1152	240 h	8	2nd sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	4	SCH	60	h	100	h
	Tuition in seminars	30 students	2	SCH	30	h	50	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students:

- know properties of different types of matrices.
- apply vectors and matrices and solve linear equations systems by Gaussian elimination method.
- outline functions of two real variables and have a view of functions of several real variables.
- set up and solve multiple integrals and are able to calculate area, volume, centre of gravity and mass.
- solve engineering problems in the form of ordinary differential equations.
- solve ordinary differential equations and are able to classify them.
- solve first-order matrix differential equation using eigenvalues and eigenvectors.
- interpret the solutions of ordinary differential equations.

3 Contents:

- Linear algebra (properties of matrices)
- Linear transformation (transformation matrix) and linear equations systems
- Eigenvalues and eigenvectors, characteristic polynomial, methods to diagonalize
- Functions of several real variables, their continuity and differentiability
- Partial derivatives, especially gradient, total differential
- Multiple integral (volume, mass, centre of gravity)
- Set up and solve ordinary differential equations
- Classification of ordinary differential equations
- Setting up and solving matrix differential equation (systems of differential equations)

4 Forms of teaching:

Lecture, seminar

5 Participation requirements:

Formal:	None
Content:	Modules: 1146 Mathematics 1

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Martin Kohlhase

11 Other information:

	Literature will be announced at the beginning of the course.
12	Language: German

Mechatronics					ME
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1164	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Technical content: multiple input multiple output (MIMO) systems, mechanical transmission elements, motion diagrams. Description of harmonic oscillations. Structure, operating behaviour and the control loops of actuators and sensors.
Skills: Determination of MIMO systems, modeling of mechanical system components. Understanding the vibration behaviour of machines and vehicles. Experimental determination of natural vibration parameters, analysis of vibration problems, determination of possible constructive solutions. Determination of harmonic oscillations from measurements (Fourier analysis).
Knowledge: Understanding of mechatronic systems. Selection of the sensors and actuators suitable for the respective operating conditions. Ability to estimate and calculate the static and dynamic parameters of the overall system.
Software tools: Matlab, Simulink.

3 Contents:

Examples of mechatronic systems, Mimo systems, identification of Mimo systems, mechanical components as a system, mechanical energy conductors, energy conductors for translational movements, energy conductors for rotational movements, mechanical converters, translations, prime movers, working machines, movement-time diagrams. Description of oscillations. Fourier transform. One-mass, two-mass and three-mass oscillators: Equations of motion, natural frequencies and natural modes of vibration. Properties of the natural oscillations. Servo systems, inverter drives, linear motors, magnetic drives, stepper motor drives, piezo and memory metal actuators, pneumatic, hydraulic and magnetostrictive actuators, micromechanical systems for actuators and sensors.

4 Forms of teaching:

Lecture, seminar-based teaching, practical course

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination, combination examination, performance examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Mechatronics B.Sc.

9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Heinrich Kühlert
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Measuring and Testing Systems					MPS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1166	150 h	5	5th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: The graduates know the basics of analogue and digital measurement data acquisition. They know important methods of digital signal processing and can apply them. They can use a programming environment (LabView) to develop a programme for automating a test system. They can determine sensor characteristics and use them.
3	Contents: - Draft - Digital measurement data acquisition - Trigger functions - Digital data processing - Sequence control and process automation - Project management
4	Forms of teaching: Lecture, seminar-based teaching, practical course
5	Participation requirements: Formal: None Content: Modules: 1169 Metrology
6	Forms of assessment: Oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Thomas Westerwalbesloh
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Metrology					MT
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1169	150 h	5	3rd or 5th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students know the general principles of metrology and the basic electrical measuring methods. They know the causes of measurement deviations and the basics of error calculation. They know how digital and electromechanical measuring instruments work in principle and can handle measuring instruments. After completing the module, they will be able to select a device suitable for a measurement task, design a measurement circuit, perform the measurements, present the measurement results in a suitable manner and perform an error analysis.

3 Contents:

- Basics, basic circuits
- Digital and electromechanical measuring instruments
- Error calculation and causes of measurement deviations
- Measurement of electrical quantities
- Stationary and dynamic behaviour of measuring systems

4 Forms of teaching:

Lecture, seminar-based teaching and practical course

5 Participation requirements:

Formal:	none Modules: 1075 Electrical Engineering 2
Content:	

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Thomas Westerwalbesloh

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Microcontrollers					MC
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1173	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students understand how a microcontroller works and assess possible applications and limitations. They will build microcontroller circuits in the laboratory according to a given circuit diagram, scrutinise the design and evaluate it using measurement techniques. The students create simple programs in C and Assembler, extend the programs and put the software into operation on the target hardware with the help of programming devices. They analyse and debug the software on the target hardware with the help of modern development environments.

3 Contents:

Overview and comparison of type families.
Structure and mode of operation of a microcontroller using the example of a current 8-bit controller.
Command set and on-chip peripherals, connection of external peripherals.
Introduction to machine language and assemblers.
Programming in C.
Solution of frequently occurring tasks in consideration of the technical and economic aspects.

4 Forms of teaching:

Lecture in seminar style with blackboard writing and projection, accompanying seminar. Practical course in the laboratory.

5 Participation requirements:

Formal:	
Content:	Modules Digital Electronics I and II (study programme in Engineering Computer Sciences. 1070 and 1045) or electronics (study programme in Electrical Engineering. 1068) should have been completed. Modules: 1045 Digital Electronics II; 1070 Digital Electronics I; 1325 Electrical Engineering Basics

6 Forms of assessment:

Written or oral examination; in each case with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

	Prof. Dr.-Ing. Thomas Hesse
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Microsystems Technology					MST
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1174	150 h	5	4th or 6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	45	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Knowledge of the materials and technologies of microelectronics and microsystems technology
- Knowledge of the main fields of application in sensor and actuator technology
- Capabilities for systematising data sheet information of micro-electromechanical systems (MEMS)
- Knowledge of system integration of MEMS
- Knowledge and skills in the simulation techniques
- Practical competence in the realisation of sensor systems with MEMS

3 Contents:

1. Materials and technologies of microsystems engineering and microelectronics
2. Sensors
3. Actuators
4. System integration
5. Simulation

4 Forms of teaching:

Lecture, practicals

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination or combination examination; each with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Zielke

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Networks and Bus Systems					NBS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1180	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	2	SCH	30	h	45	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

With reference to the contents listed below, students name and identify the elementary terms, interrelationships, requirements and classifications of networked systems. They can analyse the industrial communication of automation solutions and design and evaluate simple systems.

3 Contents:

- Communication models and network hierarchies
- Network topologies
- Serial and parallel bus systems
- Transmission media, data backup and coding, bus access procedures
- Real-time capability
- Classic fieldbus systems, especially CANopen, PROFIBUS and LON
- Ethernet and TCP/IP protocols, Ethernet-based fieldbus systems, especially POWERLINK, Ether-CAT, PROFINET and TSN
- OPC-UA

4 Forms of teaching:

Lectures, exercises, practicals

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Term paper, written examination, combination examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng

9 Importance of the grade for the final grade:

according to BRPO or SPO if ungraded elective subject

10 Module coordinator:

Prof. Dr.-Ing. Andreas Bünte

11 Other information:

Literature will be announced at the beginning of the course.
see ILIAS

12 Language:

German

Network Technology					NW
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1181	150 h	5	3rd or 5th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Students explain the basics of setting up local area networks (LAN).
- Students have a basic knowledge of the protocols used. They plan and simulate simple networks, set them up in the laboratory with a partner, configure the network devices used (router, switch, PC) and discuss the results of their work.
- The students assign the processes in an IP network to the layers of the OSI or the TCP/IP model. They can detect and eliminate configuration errors in a LAN.
- Students are familiar with the role of a switch and configure virtual LANs (VLAN).

The students name possibilities to protect a LAN from hacker attacks.

3 Contents:

- Architecture and application of computer-aided communication systems,
- Media for data transmission,
- Local networks and their characteristics,
- Subnet formation also with variable subnet lengths (VLSM),
- Protocols of data transmission in networks (network and transport layer),
- Function of important network coupling devices (especially router, switch),
- Configuration of active components for setting up networks,
- Application level services and protocols,
- Simulation and practical construction of computer networks.

4 Forms of teaching:

Lecture, seminar-based teaching, project and group work within the framework of the internship

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination, combination examination or oral examination; each with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Mechatronics B.Sc.

9 Importance of the grade for the final grade:

	according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Lutz Grünwoldt
11	Other information: Literature will be announced at the beginning of the course. Lecture notes will be provided. Each student will be a member of a Cisco class and will have access to a simulation environment and extensive online curricula. Certificates can be issued for successful participation in Cisco final exams.
12	Language: German

Numerics for Electrical Engineers					NFE
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1318	150 h	5	4th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: The students learn different basic components of numerical algorithms. They know the mathematical basics for the numerical solution of problems that occur frequently in the engineering sciences. On this basis, the students can assess the possible applications and limits of numerical methods, evaluate results and select, combine and adapt suitable methods for practical tasks.
3	Contents: The course teaches essential principles and algorithms of numerics. Standard techniques for the numerical analysis of typical problems are explained with examples. - Basics of floating point arithmetic - Root-finding algorithms - Large linear/non-linear systems of equations - Interpolation - Regression - Numerical differentiation and integration - Numerical methods for ordinary differential equations - Application examples from electrical engineering
4	Forms of teaching: Lecture, seminar-based teaching, practical course
5	Participation requirements: Formal: Content: Modules: 1146 Mathematics 1; 1152 Mathematics 2
6	Forms of assessment: Written examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr. rer. nat. Lars Fromme
11	Other information: Literature will be announced at the beginning of the course.
12	Language:

	German

Optoelectronics					OPT
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1190	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students have a basic knowledge of the elementary correlations and physical laws of light generation and detection using electronic components.
They have gained knowledge of the most important semiconductor components for converting electrical signals into optical signals and vice versa, including their manufacture and mode of operation. They have gained an overview of the areas of application of these components and can select and use them for practical applications.
The students have acquired practical skills in simple optical experimentation and in dealing with special optical components as well as tabular and graphical processing of measurement results

3 Contents:

- Physical principles of the properties of light and propagation of electromagnetic waves
- Semiconductor electronics: Fundamentals and interaction of light and matter
- Radiation detectors: thermal detectors, quantum detectors (e.g. photocells, photoresistors, photodiodes, phototransistors, CCD devices, CMOS sensors, etc.)
- Radiation emitting devices: Luminescent diodes, laser diodes, etc.
- Optical transmission technology with optical fibres

4 Forms of teaching:

Lecture, seminar-based teaching and practical training in small groups (2–4 participants)

5 Participation requirements:

Formal:	
Content:	Basic physics and electrical engineering modules, as well as those listed below: Modules: 1066 Electronics 1; 1068 Electronics 2; 1071 Electrical Engineering 1; 1075 Electrical Engineering 2; 1169 Metrology;

		1195 Physics 1; 1200 Physics 2
6	Forms of assessment: Oral examination; in each case with preliminary examination	
7	Prerequisite for the award of credit points: Module examination pass with preliminary examination	
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng	
9	Importance of the grade for the final grade: according to BRPO	
10	Module coordinator: Prof. Dr. rer. nat. Sonja Schöning	
11	Other information: Literature will be announced at the beginning of the course. Students must have sufficient knowledge and experience in the use and safety of electrical equipment	
12	Language: German	

Photovoltaic Systems					PVA
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1289	150 h	5	5th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	3	SCH	45	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	45	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

After completing the module, students will be able to:

- explain the basic physical relationships that lead to the conversion of light to electric current,
- critically compare the potential of solar radiation,
- explain the structure of photovoltaic systems and calculate their design.

3 Contents:

The photoelectric effect, electrical description of PV systems, potential of solar radiation, Construction and design of PV systems, inverter technology, MPP control mismatch considerations, lightning and fire protection, work on PV systems, tracked systems, stand-alone systems, grid connection conditions

4 Forms of teaching:

Lectures and exercises or term papers or seminar presentation

5 Participation requirements:

Formal:	None
Content:	Physics 1 (1195), Physics 2 (1200), Electrical Engineering 1 and 2 (1071, 1075), Introduction to Electrical Power Engineering (1051). Electronics (1066,1068)

6 Forms of assessment:

Written examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Jürgen Schlabbach

11 Other information:

	Schlabbach: Netzgekoppelte Photovoltaikanlagen, 2.Auflage, VDE-Verlag. Schlabbach: Netzanschluss erneuerbarer Energien, Schriften aus Lehre und Forschung der FH-Bielefeld Nr. 26. Further literature will be announced at the beginning of the course.
12	Language: German

Physics 1					PH1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1195	150 h	5	1st sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students know the structure and methodology of physics and have basic knowledge of the fundamental laws of nature of classical mechanics. They can analyse and mathematically describe motion sequences of mass points and simple bodies. They recognise problem contexts and can solve technical questions independently.
Students can carry out experiments, evaluate measurements and present the results clearly. They know the methods of error estimation of measurement results and can independently produce reports on laboratory experiments during the practical course.

3 Contents:

- Physical quantities and units
- Measurement accuracy and measurement errors
- Basic concepts of classical mechanics
- Kinematics: Description of motion
- Dynamics: Newton's axioms laws of motion
- Work and energy, conservation of energy
- Momentum and collisions
- Rotations and angular momentum
- Basic concepts of fluid mechanics

4 Forms of teaching:

Lecture, seminar with practice-oriented exercises, basic physics practical course – Part 1 (3 experiments)

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. rer. nat. Lars Fromme

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

	German

Physics 2					PH2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1200	150 h	5	2nd sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students have basic knowledge of the fundamental physical laws of nature, especially in the areas of thermodynamics, oscillations and waves and optics. They can systematically apply basic physical principles to technical problems and work out solutions independently.
The students know the scientific working method with the alternating effect of experiment and theory and can apply it. They have skills to prepare and conduct their own experiments, as well as document and critically assess the results.

3 Contents:

- Thermodynamics: Temperature, ideal gas law, laws of thermodynamics, thermal properties and processes
- Oscillations: simple harmonic motion, damped and driven oscillations, resonance
- Waves: Wave propagation, interference, reflection, transmission, refraction, diffraction, acoustic waves
- Optics: Geometrical optics, optical systems, wave optics, polarisation

4 Forms of teaching:

Lecture, seminar with practice-oriented exercises, basic physics practical course – Part 2 (3 experiments)

5 Participation requirements:

Formal:	None
Content:	Contents of the module Physics 1 (1195) Modules: 1195 Physics 1

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. rer. nat. Lars Fromme

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

	German

Practical Project / Internship					PRA
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1292	450 h	15	7th sem.	each semester	12 weeks

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	450	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: In the work term, the activities and learning outcomes imparted in the course of study are to be applied in a practice-oriented manner. To this end, students should work independently on engineering projects and develop suitable solution strategies. The main aim is to develop and expand integration, analysis and problem solving, presentation and communication skills.
3	Contents: The contents result from the field of activity of the respective chosen company or enterprise and should include an engineering task. At the end of the work term, the supervising company is to prepare an activity report and the students a final report. During the practical phase, the students should receive individual and professional advising from the supervising university lecturers.
4	Forms of teaching: Seminar-based teaching with exercises as accompanying guidance
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Term paper
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng, Mechanical Engineering B.Eng, Mechatronics B.Sc., Renewable Energies B.Eng. and Industrial Engineering and Management B.Sc.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Anton Klar
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Project					PR
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1217	150 h	5	6th sem.	Annual (Summer)	1 semester

	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
1	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	120	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	- Project planning - Ability to work in a team - Communication skills - Motivation	
3	Contents:	
	- Project management - Communication - Knowledge management - Engineering work - Presentation	
4	Forms of teaching:	
	Term paper or project work in small groups of one to two students	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	Combination exam	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes)	
	Electrical Engineering B.Eng.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Rüdiger Schultheis	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Computer Architectures					RA
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1231	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- The students know how modern computer hardware works, especially microprocessors.
- Based on the concept of a Von Neumann computer, students evaluate and analyse various basic architecture concepts.
- The students explain how Von Neumann computers can be programmed at the machine level.
- They convert number representations between any position systems.
- They explain the representation of integers and floating point numbers in different binary encodings.
- They know memory hierarchies and bus systems and advanced architecture concepts.
- They explain the computer architecture of graphics processors and analyse it in comparison to conventional computer architectures. They solve small programming tasks using IA-32 assembler. They develop small programmes for scientific computing on graphics processors (e.g. using CUDA C).

3 Contents:

- Historical overview of computer architectures
- Von Neumann architecture
- Design of digital computers and their components
- Basic functioning of processors at the register transfer level (especially in the processing of machine instructions)
- Computer arithmetic (ALUs, FPUs, coding of numbers and characters)
- Memory hierarchy (cache)
- Bus systems
- Advanced architecture concepts (pipelines, out-of-order execution, etc.)
- Computer architecture of graphics processors
- Programming in IA32 assembler
- Programming of graphics processors (e.g. via CUDA C)

4 Forms of teaching:

Lecture, seminar-style teaching (exercises if necessary), practical programming tasks in IA32 assembler, practical tasks for programming graphics processors

5 Participation requirements:

Formal:	None
Content:	Basic computer science and programming skills

		• Basic knowledge of digital technology Modules: 1045 Digital Electronics II; 1070 Digital Electronics I; 1105 Computer Science 1
6	Forms of assessment: Written examination or oral examination	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Mechatronics B.Sc.	
9	Importance of the grade for the final grade: according to BRPO	
10	Module coordinator: Prof. Dr.-Ing. Wolfram Schenck	
11	Other information: Literature will be announced at the beginning of the course.	
12	Language: German	

Automatic Control Engineering					RT
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1235	150 h	5	4th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students master

- the description and analysis of linear, time-invariant systems in the time domain and frequency domain,
- the design of single-loop control loops by means of root locus curve and frequency response methods
- the basic features of digital regulations

3 Contents:

- Basic concepts of automatic control engineering
- Description and analysis of linear, time-invariant systems in the time domain and frequency domain
- Properties of single-loop control loops in the time and frequency domain
- Design of single-loop control loops by means of root locus curve and frequency response methods
- Basic features of digital regulations

4 Forms of teaching:

Lecture with accompanying seminar exercises and practicals

5 Participation requirements:

Formal:	None
Content:	Modules Mathematics 1 (1146 or 1150) and 2 (1152 or 1156) and Electrical Engineering 1 (1071 or 1074) and 2 (1075 or 1077) should have been completed

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Weidemann

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Robotics					ROB
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1240	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students know the elementary concepts and basics of standard manipulators. Students master the basic descriptive tools and methods for modelling and calculating the forward kinematics of a kinematic chain. Through the presentation and discussion of current robot systems (incl. mobile robot systems and multimodal sensor systems), the students can grasp both the practical significance of robotics and different approaches to robot development. They will thus become capable of independent engineering thinking and working in robotics and related areas of application.

3 Contents:

Teaching content:
- Manipulators
- Robot kinematics (incl. mathematical foundations)
- Forward and inverse kinematics
- Mobile robots
- Sensors for mobile robots
- Artificial intelligence and robotics
- Behaviour-based robotics
- Learning robots

4 Forms of teaching:

Lecture, seminar-based teaching with exercises, practical course

5 Participation requirements:

Formal:	None
Content:	Mathematics 1 and 2, Computer Science, Engineering Mechanics, Electrical Engineering 1 and 2, Physics

6 Forms of assessment:

Written examination, combination examination, performance examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

8 Application of the module (in the following study programmes)

Apparative Biotechnology B.Sc., Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng., Mechatronics B.Sc. and Industrial Engineering and Management B.Sc.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. rer. nat. Martin Hülse

11 Other information:

Literature and other sources will be announced at the beginning of the course

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12	Language: German

Sensors					SEN
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1242	150 h	5	4th or 6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: The students know some basic sensor principles (inductive, capacitive, resistive, etc.) and know the physical mechanisms of action. They know typical electrical and electronic circuits for upgrading and amplifying the sensor output. The students can select a suitable sensor for the most common measuring tasks and design a measuring circuit. They can present measured results in a suitable way and document the results of their work.
3	Contents: • Measuring amplifier • AD converter types • Measuring bridges • Inductive, capacitive and resistive sensors • Temperature measurement • Optical sensors
4	Forms of teaching: Lecture, seminar-based teaching and laboratory exercises
5	Participation requirements:
	Formal: None Modules: 1068 Electronics 2; 1169 Metrology
	Content: Modules: 1075 Electrical Engineering 2
6	Forms of assessment: Written examination; each with preliminary examination
7	Prerequisite for the award of credit points: Module examination pass with preliminary examination
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: Prof. Dr.-Ing. Thomas Westerwalbesloh
11	Other information: Literature will be announced at the beginning of the course.
12	Language:

	German

Signals and Systems					SigSys
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1121	150 h	5	4th or 6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

After completing the module, students can

- name the different signal representations in time, frequency and image ranges, select the appropriate transformations and apply them,
- recognise linear and non-linear time-varying systems and explain their essential properties,
- calculate and evaluate the transition from analogue to digital signals,
- name analogue and digital modulation methods and critically compare their characteristics

3 Contents:

- Level calculation,
- Continuous-time signals and their functional transformations (Fourier series, Fourier transform, La Place transform),
- Discrete-time signals and their functional transformations (z-transform, discrete Fourier transform)
- Fundamentals of spectral analysis
- Linear time invariant systems
- Linear and non-linear distortions
- The sampling theorem
- Methods of analogue and digital modulation processes
- Three laboratory practicals in small groups

4 Forms of teaching:

Lecture, seminar-based teaching, laboratory practicals in small groups.

5 Participation requirements:

Formal:	None
Content:	Mathematics 1 (1146) and 2 (1152). Electrical Engineering 1 (1071) and 2 (1075)

6 Forms of assessment:

Written or oral examination; in each case with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Engineering Computer Sciences B.Eng

9 Importance of the grade for the final grade:

according to BRPO

10	Module coordinator: Prof. Dr.-Ing. Rüdiger Schultheis
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Simulation Technology					SIM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1244	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students:

- have an overview of the different approaches to model-based development.
- create physical and electrical models and implement them in graphical form (as a block diagram, for example) in a simulation environment (such as MATLAB/Simulink).
- derive simulation parameters from the models and configure the simulation software accordingly.
- simulate physical and electrical models on a computer and evaluate the simulation results.
- compare simulated time curves of a model with the measured signals of a real system and assess the model quality and simulation accuracy.
- can discretise continuous-time models and implement them on an embedded system in the form of difference equations (z-superposition functions).
- understand the essential principles of one-step procedures and evaluate the different procedures in terms of efficiency, stability and accuracy.
- outline and explain one-step procedures (e.g. in the direction field).

3 Contents:

- Introduction to simulation technology.
- Model-based development (software-in-the-loop, model-in-the-loop, hardware-in-the-loop and rapid control prototyping).
- Methods of modelling (types of models, physical modelling and representation in the form of block diagrams).
- Modelling of mechanical systems and electrical circuits.
- Extended state form and introduction of the descriptor form.
- Structural singularities and algebraic loops.
- Introduction in the sampling systems (difference equations and z- transformation)
- One-step procedures (Euler procedure, Heun procedure, family of Runge-Kutta procedures).
- Stability and accuracy of one-step procedures.
- Simulation practical course

4 Forms of teaching:

Lecture, seminar-based teaching with exercises, practical course

5	Participation requirements:	
	Formal:	None
	Content:	Modules: 1233 Automatic Control Engineering
6	Forms of assessment:	
	Written or oral examination; in each case with preliminary examination performance	
7	Prerequisite for the award of credit points:	
	Module examination pass with preliminary examination	
8	Application of the module (in the following study programmes)	
	Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Mechatronics B.Sc.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Martin Kohlhase	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Student Research Project					STA
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1254	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	0	SCH	0	h	0	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	2	SCH	30	h	120	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences:	
	- Project planning - Ability to work in a team - Communication skills - Motivation	
3	Contents:	
	- Project management - Communication - Knowledge management - Engineering work - Presentation	
4	Forms of teaching:	
	Homework or project work in small groups of one to two students	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	Combination exam	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes)	
	Electrical Engineering B.Eng.	
9	Importance of the grade for the final grade:	
	according to BRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Rüdiger Schultheis	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Didactics of Technology					EDU/TD
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1312	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	0	SCH	0	h	0	h
	Tuition in seminars	30 students	4	SCH	60	h	90	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Students are able to

- formulate and justify the objectives, contents and standards of vocational education and training in the industrial-technical occupations in the context of the training objective,
- plan, prepare, implement and evaluate lessons,
- systematise the methods and media specific to teaching, select and use them according to content and target group,
- incorporate the special scientific features of mechanical engineering and electrical engineering into the didactic concept,
- plan, implement and subsequently reflect on a teaching sequence,
- structure subject content in a learning-area-oriented manner and transform it didactically,
- select suitable forms of examination and justify the selection.

3 Contents:

- Educational objectives and standards, framework curricula and training plans, guidelines,
- Didactic principles of the vocational fields of study (e.g. learning field concept in mechanical and electrical engineering occupations)
- Theories, models, methods and media (e.g. planning of teaching and learning processes, problem-solving strategies in activity-oriented teaching)
- Use of communication, presentation and learning techniques.

4 Forms of teaching:

Tuition in seminars

5 Participation requirements:

Formal:	
Content:	

6 Forms of assessment:

Performance test

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Mechanical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Thorsten Jungmann

11 Other information:

12	Language: German

Technical English 1					FSE1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1085	150 h	5	1st or 3rd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture		0	SCH	0	h	0	h
	Tuition in seminars	30 students	4	SCH	60	h	90	h
	Exercise		0	SCH	0	h	0	h
	Practical or seminar		0	SCH	0	h	0	h
	Supervised self-study	30 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Expertise: Students demonstrate that they have extended their active general language competence from B1.2 and achieved a B2.1 level. They possess a sound basic vocabulary of technical English and master the contextually relevant grammar. They communicate spontaneously and fluently in engineering job situations. They formulate issues confidently, clearly and in detail in English both in speaking and writing.
- Social competence: They try out and consolidate communicative key skills in English presentations, teamwork and project work.
- Methodological competence: They use targeted strategies for content acquisition and critical analysis of technical texts and for solving contextual tasks. They can present technical issues in a way that is appropriate for the target group.
- Personal competence: They are able to take responsibility for their learning process; they research and structure authentic material, organise workloads and meet deadlines.

3 Contents:

- The students can describe relevant engineering disciplines.
- They master the core terminology of the technical topic (e.g. base units in engineering; dimensions and shapes; mathematical operations; forces and mechanisms; properties of materials; manufacturing and automation; energy and electricity; logistics; data processing and transmission).
- They possess interdisciplinary skills (emailing; project work; presentation techniques; discussing diagrams).

4 Forms of teaching:

Seminar-based teaching, individual and group work, etc.
Semester project (Assignment)

5 Participation requirements:

Formal:	None
Content:	English language competence: B1.2 (according to the European Reference Framework for Languages)

6 Forms of assessment:

Combination examination

7 Prerequisite for the award of credit points:

	70% attendance and active participation; passed semester project and written exam
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng and Renewable Energies B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: OStR Cornelia Biegler-König
11	Other information: Literature will be announced at the beginning of the course. Textbook, additional materials, intranet self-study courses
12	Language: English

Technical English 2					FSE2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1086	150 h	5	4th or 6th semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture		0	SCH	0	h	0	h
	Tuition in seminars	30 students	4	SCH	60	h	90	h
	Exercise		0	SCH	0	h	0	h
	Practical or seminar		0	SCH	0	h	0	h
	Supervised self-study	30 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Expertise: The students have an extended active language competence of the upper B2.2 level. They enhance their Technical English vocabulary and can combine it with expressions from Business English.
- Social competence: they develop sensitivity to differences in intercultural communication, especially in English-speaking business environments.
- Methodological competence: They are able to skim technical texts for essential information. They present them shortly and concisely, both in speaking and in writing. They establish wider contexts and make a critical assessment.
- Personal competence: They show English fluency and a pro-active approach to managing authentic English sources.

3 Contents:

- Students can actively participate in international conferences.
- They master the core terminology for dealing with problem-oriented case studies (e.g. Industry 4.0; automated systems; discussing readings and trends).
- They possess interdisciplinary skills (e.g. project management; business plan and marketing; economic sectors, manufacturing processes; pitching a technical product; conference posters; academic writing; persuasion strategies).

4 Forms of teaching:

Seminar-based teaching, individual and group work, etc.
Seminar project (Assignment)

5 Participation requirements:

Formal:	Modules: 1085 Technical English 1
Content:	English language competence: B2.1 (according to the European Reference Framework for Languages)

6 Forms of assessment:

Combination examination

7 Prerequisite for the award of credit points:

70% attendance and active participation, passed semester project and written exam

8	Application of the module (in the following study programmes) Electrical Engineering B.Eng, Engineering Computer Sciences B.Eng. and Renewable Energies B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: OStR Cornelia Biegler-König
11	Other information: Literature will be announced at the beginning of the course. Textbook, course supplementary materials, self-study courses Study programmes in Electrical Engineering, Engineering Computer Sciences, Renewable Energies: Elective subject
12	Language: English

Thermal Use of Renewable Energies					TNE
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1266	150 h	5	6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

The students know the basics of the supply and utilisation of renewable energies in the field of solar and geothermal energy. They understand the essential principles of the physical-technical aspects of solar and geothermal energy use. The students know the essential principles of the application areas and dimensioning of corresponding systems. They have acquired practical skills in the creation of solar thermal simulation models and can analyse their results.

3 Contents:

- Heating demand in residential buildings
- Solar thermal use of renewable energies in the low- and high-temperature range (including domestic hot water heating and backup heating, swimming pool heating, solar thermal power plants)
- Geothermal use. Functioning of the heat pump (geothermal heating and cooling)

Practical course (e.g. experiments and simulations on the dimensioning of solar thermal systems for heating drinking water and swimming pools as well as on the functioning and determination of the coefficients of performance of a heat pump)

4 Forms of teaching:

Lecture, seminar, practical course

5 Participation requirements:

Formal:	
Content:	Modules: 1198 Physics 1; 1202 Physics 2

6 Forms of assessment:

Written or oral examination; in each case with preliminary examination performance

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr. rer. nat. Sonja Schöning

11 Other information:

	Literature will be announced at the beginning of the course.
12	Language: German

Thermodynamics 1					TD1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1267	150 h	5	2nd, 4th or 6th sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	2	SCH	30	h	45	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Instrumental competence:
They are able to safely apply this knowledge of thermodynamics to technical issues.
Systematic competence:
It should be possible to recognise, describe and solve thermodynamic problems occurring in technical situations.
Communicative competence:
They have a communicative command of thermodynamics, can explain them argumentatively to experts and beginners and confidently present and defend questions of an unknown nature.

3 Contents:

- Basic concepts such as system, equilibrium, state variables, changes, processes, thermal and caloric state variables, process variables work and heat
- 1st law of thermodynamics: stationary / moving closed systems, stationary flow processes
- Ideal gases: Thermal / caloric equation of state of ideal gases, specific heat capacity, simple changes of state of ideal gases
- 2nd law of thermodynamics: Meaning, entropy
- Circular processes: simple reversible comparative processes of ideal gases: Carnot, Joule, petrol and diesel process. Definitions of work, performance, degree of effectiveness
- Real fluids, changes of state in the two-phase region, representation in various diagrams, material data calculations and tables
- Fundamentals of heat transfer

4 Forms of teaching:

Lecture and seminar

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng., Mechanical Engineering B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

	according to BRPO
10	Module coordinator: Prof. Dr. Peter Charles
11	Other information: Literature will be announced at the beginning of the course. Renewable Energies study programme: Possible elective subject
12	Language: German

Elective Module: Electronics and Automation Technology					WM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
9021	150 h	5	5th or 6th semester	each semester	1 semester

	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
1	Lecture	60 students		SCH		h		h
	Tuition in seminars	30 students		SCH		h		h
	Exercise	20 students		SCH		h		h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students		SCH		h		h

2	Learning outcomes/competences:	
3	Contents:	
4	Forms of teaching:	
5	Participation requirements:	
	Formal:	
	Content:	
6	Forms of assessment:	
7	Prerequisite for the award of credit points:	
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.	
9	Importance of the grade for the final grade:	
10	Module coordinator: Prof. Dr.-Ing. Rüdiger Schultheis	
11	Other information:	
12	Language: German	

Elective Module: Energy and Drive Technology					WM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
9022	150 h	5	5th or 6th semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students		SCH		h		h
	Tuition in seminars	30 students		SCH		h		h
	Exercise	20 students		SCH		h		h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students		SCH		h		h
2	Learning outcomes/competences:							
3	Contents:							
4	Forms of teaching:							
5	Participation requirements:							
	Formal:							
	Content:							
6	Forms of assessment:							
7	Prerequisite for the award of credit points:							
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.							
9	Importance of the grade for the final grade:							
10	Module coordinator: Prof. Dr.-Ing. Rüdiger Schultheis							
11	Other information:							
12	Language: German							

Materials in Electrical Engineering and Electronics					WE
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1279	150 h	5	1st sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

- Basic understanding of the structure, systematisation and properties of materials in electrical engineering and electronics
- Knowledge of material parameters and their determination
- Basic knowledge of manufacturing technologies of materials
- Knowledge of the properties of passive electronic components (resistors, capacitors, coils) and their areas of application
- Competence to establish the relationships between the properties of electronic components and the materials used.
- Ability to determine electrical parameters of various passive components

3 Contents:

- Structure and properties of materials
- Metallic materials
- Dielectric materials
- Magnetic materials
- Semiconductors

4 Forms of teaching:

Lecture, seminar, practical course

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination; each with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Zielke

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German

Wind Turbines					WEA
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1288	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	3	SCH	45	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	45	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	0	SCH	0	h	0	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2	Learning outcomes/competences: At the end of the module, students can: - explain the principles of fluid mechanics for the operation of wind turbines, - understand and evaluate the different generator and inverter concepts - assess and analyse the potential of wind turbines, - design wind turbines and calculate their economic efficiency.
3	Contents: Origin of wind, fluid mechanics basics, potentials of wind energy systems, lift and drag rotors; small wind systems, inverter and generator concepts, system design, grid connection conditions. Dimensioning of plants and equipment, power control, economic efficiency calculations, potential determination.
4	Forms of teaching: Lectures and exercises or term papers or seminar presentation
5	Participation requirements: Formal: None Content: Electrical Engineering 1 and 2, Materials of Electrical Engineering, Introduction to Electrical Power Engineering (1051), Electrical Machines (1059).
6	Forms of assessment: Written examination
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes) Electrical Engineering B.Eng.
9	Importance of the grade for the final grade: according to BRPO
10	Module coordinator: TBD
11	Other information: Schlabbach, Wesselak: Regenerative Energietechnik, Springer Verlag;

	Schlabbach: Netzanschluss erneuerbarer Energiequellen, Schriften aus Lehre und Forschung an der FH-Bielefeld Nr. 26; Gasch, Twele: Windkraftanlagen, BG-Teubner-Verlag; Just, Hormann, Schlabbach: Netzrückwirkungen, VWEV-Energieverlag; Further literature will be announced at the beginning of the course.
12	Language: German

State Space Control					ZRG
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
1287	150 h	5	5th sem.	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time / classroom teaching		Self-study	
	Lecture	60 students	2	SCH	30	h	45	h
	Tuition in seminars	30 students	1	SCH	15	h	22.5	h
	Exercise	20 students	0	SCH	0	h	0	h
	Practical or seminar	15 students	1	SCH	15	h	22.5	h
	Supervised self-study	60 students	0	SCH	0	h	0	h

2 Learning outcomes/competences:

Building on the basic knowledge of control and automation technology, students learn both the description and analysis of linear, time-invariant systems in state space and the design of linear state controllers and linear state observers.

3 Contents:

- Description of linear single- and multi-variable systems in the state space
- Structural system properties: Controllability, observability
- Controller design by means of pole presetting
- Design of state observers

4 Forms of teaching:

Lecture with accompanying seminar exercises and practicals.

5 Participation requirements:

Formal:	None
Content:	Automatic Control Engineering (1235), Automation Engineering (1015)

6 Forms of assessment:

Oral examination; in each case with preliminary examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8 Application of the module (in the following study programmes)

Electrical Engineering B.Eng., Engineering Computer Sciences B.Eng. and Renewable Energies B.Eng.

9 Importance of the grade for the final grade:

according to BRPO

10 Module coordinator:

Prof. Dr.-Ing. Dirk Weidemann

11 Other information:

Literature will be announced at the beginning of the course.

12 Language:

German