Hochschule Konstanz
Technik, Wirtschaft und Gestaltung

Module Handbook of

Sustainable Engineering and Future Technologies (SET)

Bachelor of Engineering

HTWG Konstanz

Refers to SPO No. 1

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Qualification Goals for the Bachelor's Degree Program Sustainable Engineering and Future Technologies (SET)

The requirements of the Competence Level 6 of the Qualification Framework for German University Degrees (version from Feb 16, 2017) and the German Qualification for Lifelong Learning (AK DQR, version from March 22, 2011) were used as a basis when determining the qualification goals for the Sustainable Engineering and Future Technologies (SET) degree program.

The SET degree program primarily provides students with professional qualifications according to the educational objectives of the universities of applied sciences with the following education goals:

- Scientific competence
- Professional competence
- Developing civic participation
- Personal development

In addition, the program also supports the students' scientific, application-oriented development, in particular by preparing them to continue their studies in master's programs in both mechanical engineering as well as electrical engineering and information technology.

The goal of the SET degree program is to provide our students with a broad foundational education that allows them to solve engineering and technical problems in all areas of electrical engineering and information technology, mechanical engineering, and the interface between the two disciplines.

Graduates from the bachelor's program in Sustainable Engineering and Future Technologies can be characterized by the following qualifications:

- A broad and integrated knowledge and understanding of scientific principles with a critical background in the most important theories, principles and methods of mechanical engineering and electrical engineering and information technology.
- The ability to apply their knowledge and understanding to conceptualize, develop, and maintain electrotechnical and IT systems, as well as to design complex machines, apparatuses and processes, and thereby systematically and efficiently find solutions to existing problems.
- Able to collect, evaluate and interpret technical information and thereby derive conclusions and independently design further learning processes.
- Competent in communicating with both specialists in their field and laypersons, both in German and English, and taking on areas of responsibility in international and interdisciplinary teams.

This broad foundational education also allows graduates to work in related fields.

The individual qualification goals can be organized into the following areas, corresponding to competence areas in the field-specific supplementary information provided by ASIIN:

A) “Knowledge and Understanding”

Graduates acquire in particular:

- A broad and in-depth mathematical, natural science and engineering knowledge base, to be able to understand complex phenomena in electrical engineering, information technology, mechanical engineering and process technology.
- An understanding of the additional multidisciplinary context of the engineering sciences.

B) “Engineering Sciences Methodology”

SET graduates can do the following:

- Select and efficiently apply the appropriate modeling, calculation, design, optimization and test methods.
- Carry out research in technical journals and other information sources relating to specific problems.
- Design and perform experiments and simulations, as well as interpret the data outcome.
- Locate and apply information from databases about norms, guidelines and safety measures.
- Carry out an in-depth scientific analysis of products, processes and methods in their discipline and evaluate the results.

C) “Develop Engineering Skills”

SET Graduates also:

- Develop analog and digital, electric and electronic circuits, systems and products, as well as prepare designs for machines, apparatuses or processes.
- Have the skills to develop design methodologies, models and tests.
- Can identify and document customer requirements and needs and integrate these in development.

D) “Engineering Practice and Product Development”

In addition, the graduates:

- Can apply their knowledge and understanding to develop products, systems and processes.
- Understand the health, safety and economic aspects of their work and act accordingly.
- Are aware of the potential consequences of their work in a social and ecological context and can take these into consideration in terms of sustainable development.
- Are capable of deepening their own knowledge independently.
- Know the practicalities and requirements of production sites.

E) “Interdisciplinary Skills”

Finally, SET graduates:

- Are able to work in an interdisciplinary manner.
- Can work successfully in teams and, when necessary, take on coordination tasks.
- Implement project, quality and risk management strategies successfully.
- Have an understanding of the health, safety and legal aspects of the engineering field, as well as the consequences of engineering solutions in a societal and ecological context.
- Possess social and ethical competences and are able to help shape societal processes in a critical, reflective, responsible and sustainable manner.
- Have both German and other language skills, which are relevant in the professional, national and international contexts in which they will work.

Study Program and Exam Plan

Basic study period (semester 1-2)

Abbreviations see footnote

	Module no.	Module / Course	Type of module	Contact hours	ECTS credits	Pass/fail coursework	Module or submodule assessment	
							pass/fail	graded
Semester 1	**1**	**Language Basics (DE)**	**PM**	**4**	**5**			**K90/S/R**
		Language Basics (DE)						
	2	**Hands-on Experience (EN/DE)**	**PM**	**4**	**5**		**L**	
		Hands-on Experience (EN/DE)		4	5			
	3	**Machine Design and CAD (EN)**	**PM**	**4**	**5**			**S**
		Machine Design and CAD (EN)		4	5	SP		
	4	**Mathematics 1 (EN)**	**PM**	**4**	**5**			**K90**
		Mathematics 1 (EN)		4	5			
	5	**Electrical Engineering (EN)**	**PM**	**4**	**5**			**K90**
		Electrical Engineering including lab (EN)		4	5	SP		
	6	**Basic Concepts of Sustainability (EN)**	**PM**	**4**	**5**			**S**
		Basic Concepts of Sustainability (EN)		4	5			
Semester 2	**7**	**Communication and Intercultural Competences (DE)**	**PM**	**4**	**5**		**S/R**	
		Communication and Intercultural Competences (DE)		4	5			
	8	**Physics (EN)**	**PM**	**4**	**5**			**K90**
		Physics including lab (EN)		4	5	SP		
	9	**Technical Mechanics (EN)**	**PM**	**4**	**5**			**K90**
		Technical Mechanics (EN)		4	5			
	10	**Mathematics 2 (EN)**	**PM**	**4**	**5**			**K90**
		Mathematics 2 (EN)		4	5			
	11	**Programming (EN/DE)**	**PM**	**4**	**5**			**K90**
		Programming including lab (EN/DE)		4	5	SP		
	12	**Electronics (EN)**	**PM**	**4**	**5**			**K90**
		Electronics including lab (EN)		2	3	SP		
		Electrical Engineering 2 (EN)		2	2			
Sum		**Basic study period (semester 1-2)**		**48**	**60**			

Main study period (semester 3-7)

	Module no. / Module / Course		Type of module	Contact hours	ECTS credits	Pass/fail coursework	Module or submodule assessment	
							pass/fail	graded
Semester 3	**13**	**Process and Material Technologies (EN)**	**PM**	**5**	**5**			**K90**
		Functional Materials (EN)		2	2			
		Functional Materials lab (EN)		1	1	SP		
		Introduction to Process Technologies (EN)		2	2			
	14	**Machine Dynamics (EN)**	**PM**	**4**	**5**			**K90**
		Machine Dynamics (EN)		4	5			
	15	**Signals and Systems (DE)**	**PM**	**4**	**5**			**K90**
		Signals and Systems including labratory (DE)		4	5	SP		
	16	**Mathematics 3 (EN)**	**PM**	**4**	**5**			**K90**
		Mathematics 3 (EN)						
	17	**Microprocessor Systems (EN)**	**PM**	**4**	**5**			**K90/L/R**
		Microprocessor Systems (EN)				SP		
	18	**Lab Project (DE)**	**PM**	**4**	**5**		**S**	
		Lab Project (DE)		4	5			
Semester 4	**19**	**Internship**	**PM**	**1**	**30**			
		Industrial Internship		0	26		S	
		Seminar		1	4		R	
Semester 5	**20**	**Control Systems (DE)**	**PM**	**4**	**5**			**K90**
		Control Systems including lab (DE)				SP		
	21	**Software Engineering + Object-oriented Programming (EN)**	**PM**	**4**	**5**			**K90**
		Software Engineering (EN)		2	2	SP		
		Object-Oriented Programming (EN)		2	3	SP		
	22	**Sensors and Drives (EN)**	**PM**	**5**	**5**			**K90, SP**
		Sensors and Data Acquisition (EN)		2	2			
		Electric Drives (EN)		2	2			
		Sensors and Drives lab (EN)		1	1			
	23	**Fluid Dynamics and Thermodynamics (DE)**	**PM**	**4**	**5**			**K90**
		Fluid Dynamics and Thermodynamics (DE)		4	5			
Semester 5-6	**Area of specialization according to section 7** (modules amounting to at least 25 ECTS credits)			**x**	**≥25**			
	3x	**Specialization module 1-7**	**WPM**	**x**	**x**			**X**
		Course in specialization module		x	x			
Semester 6	**Area of compulsory electives according to section 8** (modules amounting to at least 10 ECTS credits)			**x**	**≥10**			
	4x	**Compulsory elective module 1-n**	**WPM**	**x**	**x**		**X**	**X**
		Course in compulsory elective module		x	x			
	50	**Project & Quality Management**	**PM**	**4**	**5**			**K90/S/R**
		Project and Quality Management (EN)		4	5	S		
Semester 7	**51**	**Scientific Writing (DE)**	**PM**	**2**	**2**		**S**	
		Scientific Writing (DE)		2	2			
	52	**General Studies**	**PM**	**x**	**≥4**		**SP**	
		Selection from Studium Generale						
	53	**Project**	**PM**	**1**	**12**	**R**		**S**
	54	**Bachelor Thesis**	**PM**		**12**			**S, R**
Sum		**Main study period (semester 3-7)**		**≥50**	**150**			
Sum		**Complete study period (semester 1-7)**		**≥98**	**210**			

Abbreviations: ECTS = European Credit Transfer System; CM und CEM??;
DE = German-language event; EN = English-language event
Types of examination: Kx = written examination (x = duration in minutes); R = presentation; L = laboratory work, laboratory report, practi
PR = presentation; S = term paper, exercises; SP = other written or practical work;
X = Examination mode depends on the selected course

Content

Classification

Legend

Abbreviations

SWS	=	Semester credit hours
ECTS	=	European Credit Transfer System
PM	=	Compulsory module
WPM	=	Elective modul
GS	=	Basic studies
HS	=	Main studies
V	=	Lecture
Ü	=	Tutorial (supervised)
LÜ	=	Laboratroy exercise
W	=	Workshop, Seminar
P	=	Internship
E	=	Excursion
PSS	=	Integrated internship semester
Kx	=	Exam (x = duration in mintues)
Mx	=	Oral examination (x = duration in minutes)
R	=	Presentation
SP	=	Other written or practical work
AB	=	Papers/Reports
LP	=	Laboratory/Programming assignments
PR	=	Presentation
TE	=	Certificate
PJ	=	Project
S	=	Term paper, project work
L	=	Lab work, lab report, practical work

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Module 1	**Language Basics (DE)**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. C. Nied	SS, WS	MO 01	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	1	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: MO2 (Communication and Intercultural Competences), all modules with teaching content in German Recommended in combination with: MO2 (Communication and Intercultural Competences)

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90/S/R		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	- The students can understand and compose simple texts and reports on everyday events and link sentences using elementary linguistic elements. - They can communicate in simple, routine situations involving a simple and direct exchange of information on familiar topics (shopping, study/work, family, local area). - They can reproduce information orally when it comes to routine matters from everyday life and studies. - They can use simple means to describe their own background and education, their immediate environment and things related to immediate needs. - They can conduct short contact conversations. - They can read short, simple texts. - They can write short, simple notes and messages. - They can ask questions in class, make contact in everyday study situations using simple phrases and politely ask for advice and help.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☒ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Language Basic O. Mühlethaler	V, Ü	4	5	- Training of listening, reading, speaking, writing skills in everyday situations, partly from everyday study life. - Everyday topics such as finding accommodation, authorities, banks, working life, education and travel planning - Basic grammar - Developing aspects of the country in everyday situations and intercultural knowledge - Systematic introduction to basic vocabulary

Literature	- Pluspunkt Deutsch - Leben in Deutschland, current edition, Cornelsen Verlag, Berlin		
Language	German	**Last update**	22.09.2023

Module 2	**Hands-on Experience**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. C. Nied	SS, WS	MO 02	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	1	SPO 1 / 2023

Competence-based requirements for participation	none
Usability in above-mentioned program	Prerequisite for: MO 12 (Electronics), MO 13 (Process and Material Technologies), MO 17 (Microprocessor Systems), MO 18 (Lab Project), Areas of specialization Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)		L	
	Submodule exam (MTP)			
Calculation of the final grade	☐ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students understand basic principles of process technology. - They know about materials testing methods for metals and plastics. - They can design simple electrical circuits. - They can analyze electrical and electromechanical systems. **Methodological competencies** - The students can work in a team and present their work to others. - They are able to apply fundamental measuring/observing, documentation and evaluation techniques in a laboratory environment.

Teaching and learning methods	☐ Lecture ☐ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Hands-on Experience Prof. Dr.-Ing. C. Nied / Prof. Dr. B. Böck / Prof. Dr. H. Rebholz / Prof. Dr.-Ing. U. Behrendt / Prof. Dr. L. Boskovic / Prof. Dr.-Ing. T. Deißer	LÜ, W	4	5	- Experimental lab trials on o unit operations of environmental technology such as heating, cooling and drying o materials testing of metals and plastics o component manufacturing - Hands-on experience in o manufacturing of circuit boards and solder connections o building prototypes and series production o analysis and construction of an electromechanical system o Failure mechanisms / influence on the service life of electronic components (functional obsolescence of electronic circuits) o application of microprocessor systems

Literature	- Laboratory and experimental instructions will be provided in Moodle		
Language	German/English	**Last update**	22.02.2024

Module 3	**Machine Design and CAD**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. V. Merklinger	SS, WS	MO 03	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	1	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	S		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students have basic knowledge of engineering and design. - They know the rules of technical communication. - They can read and create technical drawings. - They understand the Process from the idea to product and know the methods. - They have basic knowledge of machine elements. - They understand the interaction beetween different parts. - They can create parts in a CAD program. **Methodological competencies** - The students can talk to others about technical parts and components. - They can create concepts. - They can plan the steps from idea to product. **Personal competencies** - The students can work together in small groups. - They can convince in technical discussions.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☒ Project ☐ Laboratory ☒ Excursion ☒ E-Learning ☒ Term paper ☐ Intensive language course ☒ Others: Flipped Classroom

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Machine Design and CAD Prof. Dr.-Ing. V. Merklinger	V, Ü	4	5	- Product design - Design methodology - Concept development - Engineering drawings - Standard parts - Machine elements - CAD Creo

Literature			
Language	English	**Last update**	02.02.2024

Module 4	**Mathematics 1**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. T. Hellmuth	SS, WS	MO 04	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	1	SPO 1 / 2023

Competence-based requirements for participation	None
Usability in above-mentioned program	Prerequisite for: Mathematics 2, Mathematics 3 Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students understand the basic principles of Differentiation and Integration, they can apply these principles to functions with one variable - They know about Sequences and Series - They are able to calculate the Taylor Series of functions with one variable - They can work with Complex Numbers **Methodological competencies** - The students can work in a team and present their work to others. - They can brake down large task and solve the subsequent task efficiently.

Teaching and learning methods	☒ Lecture ☐ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Mathematics 1 Prof. Dr. T. Hellmuth	V	4	5	The lecture "Mathematics 1" offers a comprehensive exploration of fundamental topics in mathematics, providing students with a foundation in mathematical analysis. Through a combination of theoretical discussions and practical applications, this course aims to develop students' analytical and problem-solving skills. The module covers a range of essential topics, including: - **Sequences and Series**: Students will study the behavior and properties of sequences and series, learning about convergence, divergence. - **Complex Numbers**: The module will introduce complex numbers and their algebraic operations. Students will explore the complex plane and gain an understanding of the applications of complex numbers in solving equations and problems related to electrical engineering, and other fields. - **Differentiation and Taylor Series**: Students will learn about the definition of derivatives (difference quotient), rules for computing derivatives, and techniques for finding maximum and minimum values. Additionally, the module will introduce Taylor series expansions, as these are used for system modeling in engineering - **Integration**: The module will cover the fundamentals of integration, including techniques for computing definite and indefinite integrals. Students will explore applications of integration, such as finding areas, volumes, and accumulation. The connection between differentiation and integration, including the Fundamental Theorem of Calculus, will be emphasized.

Literature	T. Westermann, Mathematics for Engineers Volume I and II, iMath, (2021) G.Baumann, Mathematics for Engineers I and II, De Gruyter, (2015) A.Croft and R. Davison, Mathematics for Engineers, Pearson (2019) G. James and P. Dyke, Modern Engineering Mathematics, Pearson (2020) K. F. Riley, et al., Mathematical Methods for Physics and Engineering, Cambridge University Press (2002)		
Language	English	**Last update**	06.03.2024

Module 5	**Electrical Engineering**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. P. Abele	SS, WS	MO 05	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	1	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Electrical Engineering 2, Electronics, Electric Drives, Microprocessor Systems Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students can calculate and analyse linear passive electrical networks. - They are familiar with the basics of electrical modeling. - They acquire basic knowledge of electric and magnetic fields. **Methodological competencies** - The students can analyse and calculate simple DC circuits **Personal competencies** - The students can linearize characteristic curves at the operation point - They are familiar with modeling of simple devices

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Electrical Engineering including lab Prof. Dr. P. Abele / Prof. Dr. C. Knievel	V, Ü	4	5	- Basic physical terms in electrical engineering - DC circuits (unbranched circuits, branched circuits, electrical energy and circuits, electrical energy and power, methods of network calculation) - Electric and magnetic fields (electric flow field, electrostatic fields, magnetic flux, induction)

Literature	- Weißgerber, Wilfried: Elektrotechnik für Ingenieure 1, Gleichstromtechnik und Elektromagnetisches Feld, Ein Lehr-und Arbeitsbuch für das Grundstudium, 11. Aufl., Springer Vieweg, 2018 (e-book).		
Language	English	**Last update**	01.02.2024

Module 6	**Basic Concepts of Sustainability**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. M. Sippel	SS, WS	MO 06	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	1	SPO 1 / 2023

Competence-based requirements for participation	No specific knowledge required
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	S		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students have a broad understanding of current global challenges (with a focus on planetary boundaries and sustainable development) - They have a critical understanding of selected approaches to solutions in technology, society, corporate sector and politics - They can developing a picture of how the sustainability transition can work, and recognising how action by individuals and companies is interlinked with structural frameworks (laws, price structures, etc.). - They understand the relevance and the potential for personal action - in work life and beyond. - They are able to develop and apply action options, both on a footprint level and adressing structural change (handprint) **Methodological competencies** - The students have the competence to conduct and evaluate a concrete implementation project for the sustainability transition, over a period of several weeks (incl. wirting a scientific report on the experiment) **Personal competencies** - The students can develop a personal and value based attitude towards sustainability (e.g. inter- and intra-generational justice), and to put one's action in line with those values. - They are motivated to use the acquired professional and methodological competences in one's own actions, promoted by experiences of self-efficacy ("learning with head, heart and hand").

Teaching and learning methods	☒ Lecture ☐ Practice ☒ Self-study ☒ Workshop/Seminar ☒ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: complex problem solving, interactive, project-based

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Basic Concepts of Sustainability Prof. Dr. M. Sippel		4	5	

Literature	- Club of Rome, 2022. Earth for All – A Survival Guide for Humanity. - WBGU (German Advisory Council on Global Change) 2014. The Great Transformation: Climate – Can we beat the Heat? Comic. - WBGU (German Advisory Council on Global Change) 2011. World in Transition – A Social Contract for Sustainability. - W. Steffen, A. Sanderson, P.D. Tyson, J. Jäger, P.A. Matson, B. Moore III, F.

	Oldfield, K. Richardson, H.J. Schellnhuber, B.L. Turner, R.J. Wasson, 2004. Global Change and the Earth System: A Planet Under Pressure.		
Language	English	**Last update**	27.07.2023

Module 7	**Communication and Intercultural Competences**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. G. Thelen	SS, WS	MO 07	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	2	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)		S/R	
	Submodule exam (MTP)			
Calculation of the final grade	☐ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	- The students are aware about misperceptions and reasons for conflict in intercultural communication, - They have basic knowledge about intercultural communication theory, - They have an enhanced personal intercultural competence through reflection about experiences in intercultural student teams (group work), - They have knowledge of German as a foreign language at the competence level B1

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☒ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Communication and Intercultural Competences Prof. Dr. G. Thelen	V, Ü, PJ	4	5	This course consists of two parts: 1) Communication (2 SWS, 3 ECTS): - German as a foreign language, competence level B1, **or** - other language course e.g. for native speakers of German (as described in the SPO). 2) Intercultural Competences (2 SWS, 2 ECTS): - Theories and models of intercultural communication and communication psychology, - experience of and reflection about individual intercultural competence, - individual intercultural coaching.

Literature	- Comfort, Jeremy & Franklin, Peter (2014), The Mindful International Manager: How to Work Effectively Across Cultures, Kogan Page: London - Gibson, Robert (2000), Intercultural Business Communication: Fachsprache Englisch, Cornelsen & Oxford University Press: Berlin - Meyer, Erin (2014,) The culture Map, PublicAffairs: New York - Thelen, Obendiek, Bai (2021), Handbuch Chinakompetenz,Transkipt: Bielefeld		
Language	German/English	**Last update**	21.02.2024

Module 8	**Physics**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. C. Hettich	SS, WS	MO 08	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	2	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students are familiar with dimensional analysis. - They can set up experiments. - They can evaluate measurements. - They can apply laws of conservation, be it momentum, energy, angular momentum, money, charge oder people by applying balancing equations. **Methodological competencies** - The students are familiar with important methods of physics.. - They can apply these methods for engineering problems. - They use units and dimensions. - They can quickly perform rough calculations without computers, even over large ranges of values. **Personal competencies** All methods and content mentioned above help in engineering courses.

Teaching and learning methods	☒ Lecture ☐ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: TeamCoaching Courses

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Physics including Lab Lehrbeauftragte*r	V, LÜ, PJ	4	5	- Scientific methods of work - Physical quantities, unit and dimensions - Computing without computers - Diagrams - Physics modeling for solving problems - Measurement and evaluation including student excperiments in laboratory - Laws of conservation and balancing momentum transfer, charge, angular momentum and more - Energy - Equation of motion

Literature	- Hettich, Jödicke, Sum; Physik Methoden, Springer, 2023 (beta version available in English) - Mahajan, Sanjoy. The Art of Insight in Science and Engineering: Mastering

	Complexity. MIT Press, 2014		
Language	English	**Last update**	26.09.2024

Module 9	**Technical Mechanics**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. L. Boskovic	SS, WS	MO 09	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	2	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Module 14 "Machine Dynamics (EN)" Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** The students know the basics of statics, in particular the calculation of forces and moments that are effective on components. **Methodological competencies** The students know the methods and calculation methods of statics and can apply them to components. **Personal competencies** The students are able to classify the importance of structural analysis in the design of components and gain important prerequisites for further teaching.

Teaching and learning methods	☒ Lecture ☒ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Technical Mechanics Prof. Dr. L. Boskovic	V, Ü	4	5	- Basic Concepts - Forces with a Common Point of Application - General Systems of Forces, Equilibrium of a Rigid Body - Center of Gravity, Center of Mass, Centroids - Support Reactions - Trusses - Beams, Frames, Arches - Work and Potential Energy - Static and Kinetic Friction - Tension and Compression in Bars - Stress - Strain, Hooke's Law

Literature	- Technische Mechanik 1 : Statik / Dietmar Gross, Werner Hauger, Jörg Schröder, Wolfgang A. Wall https://doi.org/10.1007/978-3-662-59157-4 - Engineering Mechanics 1 : Statics / by Dietmar Gross, Werner Hauger, Jörg Schröder, Wolfgang A. Wall, Nimal Rajapakse http://dx.doi.org/10.1007/978-3-642-30319-7 - Technische Mechanik 2 : Elastostatik / Dietmar Gross, Werner Hauger, Jörg Schröder, Wolfgang A. Wall https://doi.org/10.1007/978-3-662-61862-2 - Engineering Mechanics 2 : Mechanics of Materials / by Dietmar Gross, Werner Hauger, Jörg Schröder, Wolfgang A. Wall, Javier Bonet

	http://dx.doi.org/10.1007/978-3-662-56272-7 - Formeln und Aufgaben zur Technischen Mechanik 1 : Statik / Dietmar Gross, Wolfgang Ehlers, Peter Wriggers, Jörg Schröder, Ralf Müller https://doi.org/10.1007/978-3-662-61864-6 - Statics – Formulas and Problems : Engineering Mechanics 1 / by Dietmar Gross, Wolfgang Ehlers, Peter Wriggers, Jörg Schröder, Ralf Müller http://dx.doi.org/10.1007/978-3-662-53854-8 - Formeln und Aufgaben zur Technischen Mechanik 2 : Elastostatik, Hydrostatik / Dietmar Gross, Wolfgang Ehlers, Peter Wriggers, Jörg Schröder, Ralf Müller https://doi.org/10.1007/978-3-662-65052-3 - Mechanics of Materials – Formulas and Problems : Engineering Mechanics 2 / by Dietmar Gross, Wolfgang Ehlers, Peter Wriggers, Jörg Schröder, Ralf Müller http://dx.doi.org/10.1007/978-3-662-53880-7		
Language	English	**Last update**	23.02.2024

Module 10	**Mathematics 2**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. I. Lau	SS, WS	MO 10	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	2	SPO 1 / 2023

Competence-based requirements for participation	Mathematics 1
Usability in above-mentioned program	Prerequisite for: Mathematics 3 Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students have basic knowledge of linear algebra. - They know important types of differential equations and know how to solve them. - They master the handling of Laplace and Fourier transformation. **Methodological competencies** - The students master the use of mathematical formulas and algorithms. **Personal competencies** - The students can set up simple mathematical models. - They can apply the learned mathematical procedures to problems of electrical engineering,

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Mathematics 2 Prof. Dr. I. Lau	V, Ü	4	5	Linear Algebra: - Definition of matrices - Basic properties and operations of matrices - System of linear equations - Application of matrices to engineering problems Differential equations: - Definition and types of differentail equations - Types of differentail equations - Study of linear differentail equations - Application of differential equations to engineering problems Integral Transforms: - Definition of Laplace- and Fourier Transform - Properties of Laplace- and Fourier Transform - Application of Integral Transforms to mathematical and engineering problems

Literature	- S. Boyd and L. Vandenberghe. Applied linear algebra. Cambridge University Press, 2018. - G. Strang. An introduction to linear algebra. Wellseley-Cambridge Press, 2016. - T. Westermann. Mathematics for Engineers I-III. iMath, 2022. - T. Westermann. Mathematik für Ingenieure. Spribger. 2020.

	- J. Koch und M. Stämpfle. Mathematik für das Ingenieurstudium, Hanser, 2023. - M. Knorrenschild. Mathematik für Ingenieure 1. Hanser, 2021. - M. Knorrenschild. Mathematik für Ingenieure 2. Hanser, 2022.		
Language	English	**Last update**	01.02.2024

Module 11	**Programming**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. M. Froehlich	SS, WS	MO 11	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	2	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with: MO 21

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students have an insight into the historical development of programming languages. - They know the relationship between data types and memory requirements and their relevance for programming. - The participants know the importance of standard library functions like input, output and math functions. - They understand that computer languages require multiple operators, priorities and flow control elements. - Students can define data structures such as arrays, matrices and structs. **Methodological competencies** - The students know and master the subject-specific terms of computer science. - They can handle an Integrated Development Environment (IDE) and use it to create, debug, compile and execute computer programs. - The participants can interpret and draw Nassi-Shneiderman diagrams and structure algorithms programmatically. - They know the language elements to achieve this structuring and to discuss it professionally. **Personal competencies** - The students have basic knowledge and background information on computer science. - They know the basic elements of a "von Neuman architecture" and the relevance of intelligent memory management. - The participants have a first insight into data structures that lead to object-oriented languages by extension.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Programming including Lab Prof. Dr. M. Froehlich	V, Ü, PJ	4	5	- Historical Development - Programming development environments - Data types, variables and constants - Nassi Shneiderman diagrams (structograms) - Input and output - Operators and priorities - Detailed consideration of language elements - Arrays and Matrices - Structures and data type definitions - Functions - Introduction to pointers - Applications of pointers

Literature	- C Programming Language, 2nd Edition; Brian W. Kernighan (Author), Dennis M. Ritchie (Author); Pearson; 2. Edition (22. March 1988) - The C Answer Book: Solutions to the Exercises in 'The C Programming Language', 2nd Edition; Clovis L. Tondo (Author), Scott E. Gimpel (Author); Pearson; 2nd Edition (1. November 1988) - C Programming For Dummies, 2nd Edition; Dan Gookin (Author); For Dummies; 2. Edition (9. October 2020) - C Programming Absolute Beginner's Guide, 3rd Edition; Greg Perry (Author), Dean Miller (Author); Que Publishing; 3. Edition (7. August 2013) - Learn C Programming: A beginner's guide to learning the most powerful and general-purpose programming language with ease, 2nd Edition; Jeff Szuhay (Author); Packt Publishing; 2nd ed. Edition (30. August 2022)		
Language	English/German	**Last update**	01.02.2024

Module 12	**Electronics**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. C. Knievel	SS, WS	MO 12	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	2	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students can apply the fundamentals of AC technology and related procedures - They can analyze tasks related to AC technology - They are familiar with solving tasks related to AC technology - They understand the physical principles and function of selected semiconductor components - They have the knowledge of modeling the behavior of semiconductor components - They can analyze simple circuits with individual transistors and operational amplifiers **Methodological competencies** - The students can extract important parameters from the data sheets of components

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Eletrical Engineering 2 Prof. Dr. C. Knievel	V	2	2	Complex alternating current calculation - Voltage and current pointers - Series and parallel circuits - Low and high-pass filters - Oscillating circuits - Locus diagram - Three-phase systems
Eletronics including Lab Prof. Dr. C. Schick / Prof. Dr. P. Abele	V, LÜ	2	3	- Diodes - Bipolar Junction Transistors - Field Effect Transistors - Transistor Amplifiers - Transistor as a Switch - Operational Amplifiers

Literature	- Sze: Semiconductor Devices, Wiley, latest edition - Schultz, Mitchel E., Grob's basic electronics, McGraw-Hill - Storey, N. , Electronics. A System Approach, Pearson		
Language	English	**Last update**	01.02.2024

Module 13	**Process and Material Technologies**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. U. Behrendt	SS, WS	MO 13	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	5	75 h	75 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	3	SPO 1 / 2023

Competence-based requirements for participation	none
Usability in above-mentioned program	Prerequisite for: Modules of the area of specialization "Environmental Engineering" Recommended in combination with: MO 18 (Lab Project), MO 19 (Internship), MO 22 (Sensors and Drives), MO 23 (Fluid Dynamics and Thermodynamics), Modules of the area of specialization "Environmental Engineering"

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students know what process engineering is and are familiar with practical fields of application, especially in the field of environmental technology and sustainable engineering. - They can describe the most important basic operations in process engineering. - They know the basic function of important process engineering apparatus and machines. - They are able to determine initial parameters for the quantitative evaluation of material conversion processes. - They understand the influence of production and materials properties. - They have basic knowledge of different material classes. - They understand the interaction beetween materials structure and properties. **Methodological competencies** - The students can talk to others about technical parts and components. - They can choose materials according to technical specifications. - They can plan the steps for manufacturing parts and components. **Personal competencies** - The students can work together in small groups. - They can convince in technical discussions.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☒ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Functional Materials Prof. Dr.-Ing. V. Merklinger	V, Ü, W	2	2	- Material groups - Material properties - Application of materials - Material selection - Material manufacturing techniques
Functional Materials Lab Prof. Dr.-Ing. V. Merklinger	V, Ü, W	1	1	- Material characterization

Introduction to Process Technologies Prof. Dr.-Ing. U. Behrendt	V, Ü	2	2	- Process engineering applications in everyday life - Relevance of process engineering for the solution of environmental issues - Basic process engineering terms: machine, apparatus, plant, process, unit operation - Process engineering flow diagrams - Applications of mechanical process engineering - Applications of thermal processing and separation technology - Physical/chemical processes - Waste gas purification, dust removal, waste water treatment - Recycling

Literature	Introduction to Process Technology: - Ullmann's Encyclopedia of Industrial Chemistry, current edition, Wiley VCH - Ignatowitz, E., Chemietechnik, current edition, Verlag Europa-Lehrmittel - Lecture notes provided on Moodle Functional Materials: - Lecture notes provided on Moodle		
Language	English	**Last update**	02.02.2024

Module 15	**Signals and Systems**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. W. Kleinhempel	SS, WS	MO 15	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	3	SPO 1 / 2023

Competence-based requirements for participation	Mathematics 1, Electrical Engineering, Mathematics 2
Usability in above-mentioned program	Prerequisite for: Control Systems Recommended in combination with: Mathematics 3

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students know and understand the basic characteristics of analog and digital signals and systems - They now important algorithms of digital signal processing and can apply them in the context of technical tasks - They are able to design analog and digital filters - They can analyze and solve problems of signal processing **Methodological competencies** - The students are able to apply the Fourier and Laplace transform to signal and system theory questions and can interpret the results - They can analyze and visualize data with Matlab

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Signals and Systems including Lab Prof. Dr. W. Kleinhempel	V, Ü, PJ	4	5	Fundamentals of Signal Theory - Deterministic and stochastic signals - Description of signals in the time and frequency domain - Technical realization of signals as analog, sampled and digital signals Fundamentals of Systems Theory - Linear, time-invariant systems - Convolution - Frequency response, Bode diagram - Transfer function - Stability Systems, algorithms, applications - Analog filters - Digital filters - Sampling, quantization, digital signal processing - Correlation, convolution - Discrete Fourier transform Lab - Analysis of signals and simulation of systems using Matlab

Literature	Oppenheim, Schafer: Discrete Time Signal Processing, 3rd edition, Pearson Studium, 2014 Beucher: Signale und Systeme - Theorie, Simulation, Anwendung: Eine beispielorientierte Einführung mit MATLAB, 3. Aufl., Springer-Verlag, 2018 Meyer: Signalverarbeitung - Analoge und digitale Signale, Systeme und Filter, 9. Aufl., Springer-Verlag, 2021		
Language	German	**Last update**	05.07.2023

Module 16	**Mathematics 3**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. T. Raff	SS, WS	MO 16	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	3	SPO 1 / 2023

Competence-based requirements for participation	Mathematics 1, 2
Usability in above-mentioned program	Prerequisite for: Control Systems Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** Systems of differential equations: - The students can solve coupled linear differential equations in the time and frequency domain - They can analyze system stability of linear systems Statistics and probability calculus: - The students have basic knowledge in the field of probability calculus - They know some important discrete and continuous distribution functions, their parameters and their typical areas of application - They can analyze bivariate random variables - They can characterize data sets using the most important terms of descriptive statistics **Methodological competencies** - The students can recognize and use connections between different areas of mathematics - They can identify which stochastic model resp. which distribution function to use for an application problem

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Mathematics 3 Prof. Dr. T. Raff	V, Ü	4	5	Systems of differential equations: - solution using eigenvalues and eigenvectors - solution using matrix exponential - solution using Laplace transform - analysis of stability using eigenvalues Statistics and probability calculus: - basics of probability calculus (including conditional probability, independence) - discrete and continuous distribution functions and their parameters - covariance and correlation - parameters for data sets: histograms, location and dispersion parameters, boxplot

Literature	- F. Dekking et al. A Modern Introduction to Probability and Statistics. Springer, 2005 - H. Riley. Mathematical Methods for Physics and Engineering: A Comprehensive

	Guide. Cambridge University Press, 2006. - K. Stroud, D. Booth. Engineering Mathematics. Bloomsburry, 2020. - T. Westermann. Mathematics for Engineers III. iMath, 2022. - T. Westermann. Mathematik für Ingenieure. Springer, 2020. - J. Koch, M. Stämpfle. Mathematik für das Ingenieurstudium Hanser, 2023.		
Language	English	**Last update**	01.02.2024

Module 17	**Microprocessor Systems**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 17	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	3	SPO 1 / 2023

Competence-based requirements for participation	MO05, MO11, MO12
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90/L/R		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students are familiar with the basic characteristics of microprocessor systems, different microcontroller architectures and the internal structure of microcontrollers, CPU, memory, peripheral components, etc. and can explain and discuss these topics. - They are familiar with the special requirements of hardware-related microcontroller programming, they can explain and discuss these topics and use and apply this knowledge to develop basic embedded systems. - They are proficient in programming a microcontroller in C. - They can connect different external sensors and actuators to a microcontroller using various communication protocols in order to create a more complex system. - They have the technical knowldege to analyze and evaluate the sustainability implications of different design choices and technologies. **Methodological competencies** - The students can independently collect and extract relevant information, e.g. from data sheets. - They can select, apply, and use appropriate (software) tools and methods to develop embedded systems. - They are familiar with an Integrated Development Environment and in-circuit debugging for the development of embedded systems. - They are familiar with a systems thinking approach, considering the interconnectedness of various components and their environmental impacts throughout a product lifecycle. **Personal competencies** - They can work together in project teams in a goal-oriented manner - They can argue convincingly in technical presentations and discussions in English

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Microprocessor Systems Prof. Dr. B. Böck	V, Ü, PJ	4	5	- Introduction to Microprocessor systems - Internal structure of microcontrollers, Architecture, CPU, memory technologies, peripheral components, ADC, timer, watchdog, UART, etc. - Interrupts and Exceptions - Integrated Development Environment, toolchain, debugging - Interfacing with external sensors and actuators - Hardware-related microcontroller programming in C and Assembler - Various software exercises - Aspects of sustainability: Energy efficiency, product longevity and upgradability, materials/components selection - Lifecycle assessment

Literature	- TI website: datasheets and app. Notes - Brock J. LaMeres, Embedded Systems Design using the MSP430FR2355 LaunchPad, Springer, 2. Auflage 2023, available as eBook - Wüst, Klaus: Mikroprozessortechnik: Grundlagen, Architekturen und Programmierung, Vieweg+Teubner, 4. Auflage, 2011 - Miroslav Cina, MSP430 Microcontroller Essentials (2022), Elektor, Aachen, available as eBook - Wiegelmann, Jörg: Softwareentwicklung in C für Mikroprozessoren und Mikrocontroller, VDE Verlag, 7. Auflage, 2017 - Slobodan Dmitrović, Modern C for Absolute Beginners : A Friendly Introduction to the C Programming Language, Springer, 2021, eBook - Brinkschulte, Uwe, Ungerer, Theo: Mikrocontroller und Mikroprozessoren, Springer, 3. Auflage, 2010		
Language	English	**Last update**	01.02.2024

Module 18	**Lab Project**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 18	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	3	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)		S	
	Submodule exam (MTP)			
Calculation of the final grade	☐ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students have knowledge in the field of the chosen project. - They can assess the sustainability implications of different design choices and technologies **Methodological competencies** - The students are proficient in literature research and source study. - They can apply engineering working methods. - They can break down the project into subtasks. - They can document their project results according to scientific standards. **Personal competencies** - The students look for a project idea that matches their interests. - They can divide the project into subtasks. - They can distribute the subtasks within the team. - They can find their role within the team. - They can contribute their strengths to the team. - They can identify their weaknesses and gaps in the project, and compensate for them dynamically within the team.

Teaching and learning methods	☐ Lecture ☐ Practice ☒ Self-study ☐ Workshop/Seminar ☒ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Lab Project Prof. Dr. B. Böck	P	4	5	- The focus of the lab project can be experimental (e.g. conception and set-up of a test rig, execution of the experiments and evaluation, evaluation and documentation of the results), or practical (technical development). - The project topic can be self-developed or given by a professor. - The project work is to be carried out as a team project and is accompanied by a professor in an advisory capacity. - To document the course and results of the project, the team jointly prepares a written paper according to scientific standards. Each team member marks the parts contributed by him/her, so that the individual performance can be evaluated. - In line with the sustainability objectives of the study programme, relevant key aspects should be considered in project implementation where appropriate, such as: materials selection, energy efficiency, product longevity and upgradeability, recycling and end-of-life management, supply chain transparency.

Literature	- Literature/media/information available depending on project topic chosen.		
Language	German	**Last update**	20.07.2023

Module 19	**Internship**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. P. Stein	SS, WS	MO 19	30	900 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	27	15 h	885 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	4	SPO 1 / 2023

Competence-based requirements for participation	Passed basic study period
Usability in above-mentioned program	Prerequisite for: Project, Bachelor thesis Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)			
	Submodule exam (MTP)			S, R
Calculation of the final grade	☐ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students have been able to apply the skills acquired during their studies in an industrial context. - They acquire specialised knowledge in at least one field of electrical, mechanical or environmental engineering. - They have reflected their professional interests within the study framework. **Methodological competencies** - The students are able to present their work results comprehensibly and convincingly. - They are able to independently familiarise themselves with an industrial task and achieve appropriate results. **Personal competencies** - The students are able to apply adequately to qualified companies. - They can integrate themselves into professional working groups. - They have reflected on and evaluated the experiences of the practical semester.

Teaching and learning methods	☐ Lecture ☐ Practice ☒ Self-study ☒ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: Integriertes Praxissemester

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Industrial Internship Prof. Dr. P. Stein	PSS	26	26	- Treating an electrical, mechanical or environmental engineering problem in an industrial context independently and comprehensively - Getting to know industrial working environments in the field of electrical, mechanical or environmental engineering - The subject can be selected according to the student's own focus within the field of electrical, mechanical or environmental engineering.

Seminar Prof. Dr. P. Stein	W	1	4	- Objectives and procedure of the industrial internship - Planning the industrial internship - Company search and application process - Presentation of individual experience reports in the follow-up seminar - Documentation of practical work in the form of a written report (internship report) - Professional and personal reflection on the experience gained

Literature	- https://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/techreportwriting - Hering, H., Technische Berichte, current edition, Springer Vieweg, Wiesbaden (also available as eBook)		
Language	German/English	**Last update**	02.02.2024

Module 20	**Control Systems**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. J. Reuter	SS, WS	MO 20	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	5	SPO 1 / 2023

Competence-based requirements for participation	Linear Algebra, Odinary DIfferential Equations, Integral Transformations
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students can model and analyse simple dynamical systems in the state space domain - They can choose suitable control algorithms for a given control problem - They can parametrize feedback controllers systematically - They can develop control designs for setpoint control and disturbance rejection **Methodological competencies** - The students can apply frequency domain methods for the analysis and design of control loops - They can analyse the stability properties of dynamical systems and control loops - They know and can apply design methods, such as loop shaping and pole placement systematically - They know about practical means to improve the performance such as pre filtering and anti-windup methods **Personal competencies** - The students are able to solve control engineering tasks in various technical domains - They are able to explain the significance of control engineering for technical and non-technical areas - They are enabled to endevour on complex control systems by themselves or in teams - They can reflect the potential critical impact of there development in regard of ethics and sustainabiility

Teaching and learning methods	☒ Lecture ☒ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Control Systems Prof. Dr. J. Reuter	V, Ü, LÜ	4	5	- Objectives of feedback control design - Description of dynamical systems in state space and frequency domain - Modeling of dynamical systems - Stationary points and linearization - Topologies of Control Loops - Analysis on stability of control loops - Controller Types and Performance Design - Design of control loops - Practical considerations when implementing controller - Integrated Lab course and homework assignments

Literature	- Åström, Murray: Feedback Systems, PRINCETON UNIVERSITY PRESS (2012) ISBN-13: 978-0-691-13576-2 - Friedland: Control System Design, Dover (2005) ISBN 0-486-44278-0 - Franklin, Powell, Emami-Naeini: Feedback Control of Dynamic System (2006) ISBN 0-13-149930-0 - Lunze: Regelungstechnik 1, Springer (2020) ISBN 978-3-662-60746- - Schulz / Graf: Regelungstechnik 1, De Gruyter (2015) . ISBN 978-3-11-041445-5		
Language	German	**Last update**	01.02.2024

Module 21	**Software Engineering + Object-Oriented Programming**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Lehner	SS, WS	MO 21	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	5	SPO 1 / 2023

Competence-based requirements for participation	MO 11
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			SP, SP
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - Students are familiar with the basic software technologies - They are able to evaluate the use of software technologies in order to become self-sufficient in this rapidly evolving area - They are able to analyze and evaluate software engineering issues and problems - They are able to develop high quality software components for electrical engineering applications - They know and understand the three main principles of object-oriented programming for developing software - They can install software development tools on a computer - They know and can use an integrated development environment (IDE) to create object-oriented programs - They understand the concepts of event-driven graphical user interfaces (GUI), and can use tools for quickly designing such graphical user interfaces **Methodological competencies** - Students know the tasks, methods and tools of professional software development - They can act in the various roles of modern software development processes - They can transform a written problem description into a first draft of an object-oriented software design - They can translate a software design specified as a UML class diagram into an object-oriented program - They can use software development tools to analyze and optimize object-oriented programs and to find and remove bugs - They are able to write object-oriented programs with a well-structured error handling concept **Personal competencies** - Students can act in the various roles of modern software development processes - They can independently obtain information on specific issues and use it in a targeted manner - They can work and communicate in groups - They can judge their own software development skills

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Software Engineering Prof. Dr. J. Römer	V, Ü	2	2	- Software development processes and quality management - Requirement engineering (incl. Use-Case Diagram, Activity Diagram) - Software architecture and design (incl. Class Diagram, Sequence Diagram, State Machine Diagram) - Design patterns - Software tests - Working in teams (incl. issue tracker, version control, GitLab, Github Flow) - Databases and data description languages
Object-Oriented Programming Prof. Dr. B. Lehner	V, Ü	2	3	- Objects and Classes - Cooperating Objects - Encapsulation - Inheritance - Polymorphism - Abstract Classes - Errors and Exceptions

Literature	- Lecture notes and exercise sheets in the moodle course for this module - Johannes Bergsmann; Requirements Engineering für die agile Softwareentwicklung; dpunkt.verlag - Bernhard Lahres, Gregor Bayman, Stefan Strich; Objektrorientierte Programmierung; Rheinwerk Computing - Besides that, there are frequently new publications. According to the principle of lifelong learning, we recommend that the students have a look at these publications and find the book that best suits their own style of learning		
Language	English	**Last update**	01.02.2024

Module 22	**Sensors and Drives**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. H. Gimpel	SS, WS	MO 22	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	5	75 h	75 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	5	SPO 1 / 2023

Competence-based requirements for participation	Physics, Electrical Engineering, Programming
Usability in above-mentioned program	Prerequisite for: many specialised modules Recommended in combination with: Signals and Systems, Microprocessor Systems

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90+SP		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☒ Others: lectures and lab need to be taken in same semester			

Learning objectives	**Subject-specific competencies** - The students have basic knowledge of sensors and data processing relevant to mechatronic engineering. - They understand that measuring tasks are almost always solved in an interdisciplinary way (physics, electrical engineering, mechanical engineering, software). - They have basic knowledge in digital acquisition and analysis of measurement data. - They know the methods and concepts that can be used to solve data acquisition tasks. - They have the ability to select the appropriate measurement methods and suitable sensors for a measurement task. - They describe the task for a drive system and the interaction of drive and load. - They distinguish between the different types of electrical machines and their fields of application. - They derive quantitative statements from characteristic curve diagrams of electric motors. - They draw qualitative and quantitative conclusions from descriptions and data sheets of electric motors. - They design a drive system, consisting of frequency converter, motor and gearbox, for a given task. - They know how to apply sensors and drives to aquire information and to solve challenges in future technologies like energy production or robot engineering. **Methodological competencies** - The students can plan the practical procedure for a measurement on an experimental setup and check the results for plausibility - They can document experimental results in a laboratory report according to specifications. - They work out a specification in small groups and present them to an audience. - They talk to others about sensors and electric drives. **Personal competencies** - The students can work together in a small group on one lab setup. - They convince and be convinced in technical discussions. - They use and understand the technical terms related to system dynamics in technical discussions and in technical reports.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☒ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Sensors and Data Acquisition Prof. Dr. H. Gimpel / Prof. Dr. C. Hettich	V	2	2	- basics of data acquisition - calculation of measurement uncertainty according to GUM - physics of operating principles used in sensors - important sensors and measuring methods in mechatronics - digital data acquisition and signal analysis methods
Electric Drives Prof. Dr. U. Kosiedowski	V	2	2	- Physical principles of torque generation - Mechanical transmission elements - DC motor o Design o Static and dynamic behaviour o Inverter and control - BLDC motor o Commutation o Inverter - Permanent Magnet Synchronous Motor - Induction Motor o Working principle o Frequency inverter - Stepper Motors o Types and working principles o Commutation and inverters
Sensors and Drives Laboratory Prof. Dr. H. Gimpel / Prof. Dr. U. Kosiedowski / Prof. Dr. C. Hettich	LÜ	1	1	- measurement of force, torque, pressure, length, temperature, level, rotation speed, vibration - digital data acquisition with LabView or Arduino - asynchronous motor - BLDC motor

Literature	- detailed lecture notes - further literature will be given in the lecture		
Language	English	**Last update**	06.06.2023

Module 23	**Fluid Dynamics and Thermodynamics**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. A. Lohmberg	SS, WS	MO 23	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	5	SPO 1 / 2023

Competence-based requirements for participation	MO 4 (Mathematics 1), MO 8 (Physics), MO 10 (Mathematics 2)
Usability in above-mentioned program	Prerequisite for: Areas of specialization Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students are familiar with fluid properties. - They can apply laws of conservation (mass, momentum, energy) by applying balancing equations. - They can calculate losses for internal and forces for external flows. - They are familiar with the basics of thermodynamics, including their physical background and are able to perform thermodynamic calculations. - They are able to apply the main laws of thermodynamics and solve practical problems with them. - They can deal with ideal gas equations and real gases as well as calculate state changes within thermal cycle processes. - They are able to understand when to calculate with ideal gas equations and when to calculate with real gas. **Methodological competencies** - The students are familiar with important methods of fluidmechanics and thermodynamics. - They can apply these methods for engineering problems. - They can quickly perform rough calculations without computers and know how to optimize systems. - They are familiar with the practical application of thermodynamics and fluid mechanics, especially in the context of energy and environmental technology. **Personal competencies** - All methods and contents mentioned above help in engineering courses

Teaching and learning methods	☒ Lecture ☐ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Fluid Dynamics and Thermodynamics Prof. Dr. A. Lohmberg / Prof. Dr. P. Stein	V	4	5	Fluid Dynamics: - Basic principles - Fluid statics - Kinematics - Conservation of mass - Conservation of momentum - Conservation of energy - Turbulence, internal and external flows Thermodynamics: - Basics of thermodynamics (main laws) - Changes of state - Ideal gases - Multiphase systems

Literature	**Fluid Dynamics** - Bschorer, S., Technische Strömungslehre: Lehr- und Übungsbuch, Springer Vieweg, 2018 - Bohl, W., Technische Strömungslehre, Vogel, 2014 - Nuggenhalli, S., Nandagopal, PE., Fluid and Thermal Sciences : A Practical Approach for Students and Professionals, Springer, 2022 **Thermodynamics** - Langeheinecke, K.: Thermodynamik für Ingenieure, Springer, 2020 - Schmidt, A., Technical Thermodynamics for Engineers, Springer, 2019		
Language	German	**Last update**	02.02.2024

Module 3xES	**Area of specialization - Energy Science and Technology - Module 1-7**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 3x ES	25	750 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	2 Semester	20	300 h	450 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	WPM	5	SPO 1 / 2023

Competence-based requirements for participation	Modules from semesters 1-6, depending on the area of specialization
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	X	X	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - Students have acquired or deepened their technical competencies in the field of Energy Science and Technology - They are familiar with the basic concepts in the field of sustainable energy generation and storage and can explain and discuss these topics - They are familiar with the smart grids required for tomorrow's energy distribution and can explain and discuss these topics. - They can select and apply practical tools and methods in a targeted manner. - See also module description of the selected specialization modules. **Methodological competencies** - Students can select, apply, and use appropriate (software) tools and methods to solve given problems. - They can work in an interdisciplinary manner - See also module description of the selected specialization modules. **Personal competencies** - They can work together in project teams in a goal-oriented manner - They can argue convincingly in technical presentations and discussions in both English and German - They are able to reflect on their interests and strengths. - They can compile an individual list for themselves from the courses offered in the elective area. - See also module description of the selected specialization modules.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☒ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Course in Area of Specialization - Energy Science and Technology Prof. Dr. B. Böck	X	20	25	A catalog of possible specialization modules is published for each of the specialization areas before the beginning of the fifth semester. A total of at least 25 ECTS credits must be taken in the area of specialization. The selection must contain a minimum of four and a maximum of seven modules (depending on the size of the individual modules). Examples for possible modules for the area of specialization "Energy Science and Technology" are: - Energiesysteme - Energy storage and conversion - Electric Power Systems - Smart Grids - Regenerative Energiewirtschaft - Energieversorgung

Literature	- Subject-specific literature according to the selected specialization modules.		
Language	German/English	**Last update**	28.08.2023

Module 3xSM	**Area of specialization - Sustainable Mobility - Module 1-7**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 3x SM	25	750 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	2 Semester	20	300 h	450 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	WPM	5	SPO 1 / 2023

Competence-based requirements for participation	Modules from semesters 1-6, depending on the area of specialization
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	X	X	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - Students have acquired or deepened their technical competencies in the field of Sustainable Mobility - They are familiar with electric drives and sensor technologies and can explain and discuss these topics. - They can design and develop high-performance and intelligent and autonomous vehicles with diverse sensor technology - They are familiar with alternative mobility concepts and can explain and discuss these topics. - See also module description of the selected specialization modules. **Methodological competencies** - Students can select, apply, and use appropriate (software) tools and methods to solve given problems. - They can work in an interdisciplinary manner - See also module description of the selected specialization modules. **Personal competencies** - They can work together in project teams in a goal-oriented manner - They can argue convincingly in technical presentations and discussions in both English and German - They are able to reflect on their interests and strengths. - They can compile an individual list for themselves from the courses offered in the elective area. - See also module description of the selected specialization modules.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☒ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Course in Area of Specialization - Sustainable Mobility Prof. Dr. B. Böck	X	20	25	A catalog of possible specialization modules is published for each of the specialization areas before the beginning of the fifth semester. A total of at least 25 ECTS credits must be taken in the area of specialization. The selection must contain a minimum of four and a maximum of seven modules (depending on the size of the individual modules). Examples for possible modules for the area of specialization "Sustainable Mobility" are: - Antrieb und Energieversorgung in Fahrzeugen - Autonomes Fahren - Connected Vehicle Services - Digital Control Systems - Electric Drives and Actuators - Fahrzeugtechnik, Fahrassistenzsysteme - Labor Fahrzeugtechnik

Literature	- Subject-specific literature according to the selected specialization modules.		
Language	German/English	**Last update**	28.08.2023

Module 3xEE	**Area of specialization - Environmental Engineering - Module 1-7**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 3x EE	25	750 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	2 Semester	20	300 h	450 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	WPM	5	SPO 1 / 2023

Competence-based requirements for participation	Modules from semesters 1-6, depending on the area of specialization
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	X	X	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - Students have acquired or deepened their technical competencies in the field of Environmental Engineering and industrial environmental protection - They have the necessary knowledge, master practical tools and methods and can apply them in a targeted manner when dealing with concrete problems. - They can design efficient and resource-saving production processes through the application of modern sensor technology, automation technology and artificial intelligence - See also module description of the selected specialization modules. **Methodological competencies** - Students can select, apply, and use appropriate (software) tools and methods to solve given problems. - They can work in an interdisciplinary manner - See also module description of the selected specialization modules. **Personal competencies** - They can work together in project teams in a goal-oriented manner - They can argue convincingly in technical presentations and discussions in both English and German - They are able to reflect on their interests and strengths. - They can compile an individual list for themselves from the courses offered in the elective area. - See also module description of the selected specialization modules.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☒ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Course in Area of Specialization - Environmental Engineering Prof. Dr. B. Böck	X	20	25	A catalog of possible specialization modules is published for each of the specialization areas before the beginning of the fifth semester. A total of at least 25 ECTS credits must be taken in the area of specialization. The selection must contain a minimum of four and a maximum of seven modules (depending on the size of the individual modules). Examples for possible modules for the area of specialization "Environmental Engineering" are: - Automatisierungstechnik - Computer Aided Process Engineering 2 - Energy Storage and Conversion - Industrieller Umweltschutz - Nachhaltige Prozesse - Process Equipment - Prozessautomatisierung

Literature	- Subject-specific literature according to the selected specialization modules.		
Language	German/English	**Last update**	28.08.2023

Module 3xDE	**Area of specialization - Data Based Engineering - Module 1-7**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 3x DE	25	750 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	2 Semester	20	300 h	450 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	WPM	5	SPO 1 / 2023

Competence-based requirements for participation	Modules from semesters 1-6, depending on the area of specialization
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	X	X	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - Students have acquired or deepened their technical competencies in the field of Data Engineering - They have the necessary knowledge, master practical tools and methods and can apply them in a targeted manner when dealing with concrete data engineering and data analysis problems. - See also module description of the selected specialization modules. **Methodological competencies** - Students can select, apply, and use appropriate (software) tools and methods to solve given problems. - They can work in an interdisciplinary manner - See also module description of the selected specialization modules. **Personal competencies** - They can work together in project teams in a goal-oriented manner - They can argue convincingly in technical presentations and discussions in both English and German - They are able to reflect on their interests and strengths. - They can compile an individual list for themselves from the courses offered in the elective area. - See also module description of the selected specialization modules.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☒ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Course in Area of Specialization - Data Based Engineering Prof. Dr. B. Böck	X	20	25	A catalog of possible specialization modules is published for each of the specialization areas before the beginning of the fifth semester. A total of at least 25 ECTS credits must be taken in the area of specialization. The selection must contain a minimum of four and a maximum of seven modules (depending on the size of the individual modules). Examples for possible modules for the area of specialization "Data Based Engineering" are: - Applications and basics of artificial inelligence - Design of Experiments - Einführung in Python - Machine Learning - Supervised and Deep Learning - Machine Learning - Unsupervised and Reinforcement Learning - Numerik und Stochastik - Programmieren und Simulation mit Grundlagen für Industrie 4.0

Literature	- Subject-specific literature according to the selected specialization modules.		
Language	German/English	**Last update**	28.08.2023

Module 3xCS	**Area of specialization - Robotics and Cyberphysical Systems - Module 1-7**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO 3x CS	25	750 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	2 Semester	20	300 h	450 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	WPM	5	SPO 1 / 2023

Competence-based requirements for participation	Modules from semesters 1-6, depending on the area of specialization
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	X	X	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - Students have acquired or deepened their technical competencies in the field of Robotics and Cyberphysical Systems - They have the necessary knowledge, master practical tools and methods and can apply them in a targeted manner when dealing with concrete problems. - They have the necessary knowledge in the areas of sensors, drives, image processing and artificial intelligence to develop autonomous and networked systems. - See also module description of the selected specialization modules. **Methodological competencies** - Students can select, apply, and use appropriate (software) tools and methods to solve given problems. - They can work in an interdisciplinary manner - See also module description of the selected specialization modules. **Personal competencies** - They can work together in project teams in a goal-oriented manner - They can argue convincingly in technical presentations and discussions in both English and German - They are able to reflect on their interests and strengths. - They can compile an individual list for themselves from the courses offered in the elective area. - See also module description of the selected specialization modules.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☒ Workshop/Seminar ☒ Project ☒ Laboratory ☐ Excursion ☒ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**

Course in Area of Specialization - Robotics and Cyberphysical Systems CS Prof. Dr. B. Böck	X	20	25	A catalog of possible specialization modules is published for each of the specialization areas before the beginning of the fifth semester. A total of at least 25 ECTS credits must be taken in the area of specialization. The selection must contain a minimum of four and a maximum of seven modules (depending on the size of the individual modules). Examples for possible modules for the area of specialization "Robotics and Cyberphysical Systems" are: - Application and basics of artificial intelligence - Digital Control Systems - Elektrische Maschinen und Aktoren - Kommunikationstechnik - Leistungseletronik - System Architecture - Verteilte Systeme

Literature	- Subject-specific literature according to the selected specialization modules.		
Language	German/English	**Last update**	28.08.2023

Module 4x	**Compulsory elective module 1-n**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. C. Nied	SS, WS	MO 4x	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	WPM	6	SPO 1 / 2023

Competence-based requirements for participation	Depending on the content, modules from semesters 1-5
Usability in above-mentioned program	Prerequisite for: Recommended in combination with: MO 3x (Specialization Modules)

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	X	X	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students are able to acquire in-depth knowledge in a specific subject area. - Please also refer to the module description of the selected compulsory elective modules. **Methodological competencies** - The students will be able to use integrative, cross-functional and cross-disciplinary concepts and models for the solution of interdisciplinary problems. - Please also refer to the module description of the selected compulsory elective modules. **Personal competencies** - The students are aware of the complex processes that occur in interdisciplinary cooperation. - They are able to reflect on their interests and strengths. - They can compile an individual list for themselves from the courses offered in the compulsory elective area. - Please also refer to the module description of the selected compulsory elective modules.

Teaching and learning methods	☐ Lecture ☐ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: Depending on the chosen modules

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Course in compulsory elective module Prof. Dr.-Ing. C. Nied	X	4	5	In the module group "Area of compulsory electives", students can freely choose modules from a catalog of elective courses. The area of compulsory electives allows the students to supplement their competence profile from a selection of modules of their choice. As long as the selection is made from the Electives catalog of the SET degree program, approval by the dean of studies is not required, unlike in the areas of specialization. The selection of modules that are not included in the Electives catalog of the SET degree program must be approved by the dean of studies. The Electives catalog of the SET degree program is published at the beginning of each semester.

Literature	- Subject-specific literature according to the module description of the selected compulsory elective modules		
Language	German/English	**Last update**	02.02.2024

Module 50	**Project and Quality Management**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. M. Haberstroh	SS, WS	MO 50	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	6	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90/S/R		
	Submodule exam (MTP)			S
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students know the factors to plan and carry out projects successfully - They know the values and principles of Agile Management and know the Scrum Approach - They know the basics of quality management including the current quality management systems (e.g. ISO 9000 ff.) **Methodological competencies** - The students can apply the methods of traditional project management - They know the steps of the Scrum Approach - They know the basic quality management methods **Personal competencies** - The students practice to work in teams - They present their team's results in English - They can manage their time efficiently

Teaching and learning methods	☒ Lecture ☒ Practice ☐ Self-study ☒ Workshop/Seminar ☒ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Project and Quality Management Prof. Dr. M. Haberstroh / Prof. Dr. M. Haberstroh	V, Ü, W	4	5	- Basics of projects and project management - Elements of traditional project management: 1. Project Order, 2. Objectives, 3. Stakeholder/Context, 4. Risk Management, 5. Project Organization, 6. Phases & Milestones, 7. Work Breakdown Structure, 8. Schedule, 9. Resources, 10. Cost Planning, 11. Project Execution + Monitoring & Control - Basics of Agile Management and Scrum Approach - Basics of quality management + quality management systems (e.g. ISO 9000 ff.) - Work on an individual quality management topic - Apply PM-methods in a team project

Literature	- GPM Deutsche Gesellschaft für Projektmanagement e.V. (Ed.) (2019): Kompetenzbasiertes Projektmanagement (PM4), Band1 + Band 2,

	Nürnberg/Berlin. - Herrmann, Joachim; Fritz, Holger (2016): Qualitätsmanagement. Lehrbuch für Studium und Praxis, 2. Auflage, München. - Linß, Gerhard (2018): Qualitätsmanagement für Ingenieure, 4. Auflage, München. - Project Management Institute (2017): A guide to the project management body of knowledge, 6th edition, Newton Square (Pennsylvania). - Sutherland, Jeff; Schwaber, Ken (2020): The Scrum Guide, https://scrumguides.org/ (access: June 29, 2023) - Timinger, Holger (2017): Modernes Projektmanagement, Weinheim. - See lecture notes		
Language	English	**Last update**	20.07.2023

Module 51	**Scientific Writing**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. C. Nied	SS, WS	MO 51	2	60 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	2	30 h	30 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	7	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: MO BA, Bachelor Thesis Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)		S	
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students are able to structure and write a thesis complying with scientific writing standards. - They are able to to cite and reference literature according to good scientific practice. **Methodological competencies** - The students are familiar with and know relevant tools for literature search. - They can argue scientifically in a reader-friendly way. **Personal competencies** - The students know useful techniques to organize and structure the writing process.

Teaching and learning methods	☒ Lecture ☒ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Scientific Writing Lehrbeauftragte*r	V, Ü	2	2	- Concept of good scientfic practice - Literature search and search tools - Scientific citation and bibliography - Organization of the writing process - How to strucure and write a thesis

Literature	- https://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/techreportwriting - Hering, H., Technische Berichte, current edition, Springer Vieweg, Wiesbaden (also available as eBook) - Other subject-related literature will be announced in the course		
Language	German	**Last update**	01.02.2024

Module 52	**General Studies**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. C. Nied	SS, WS	MO 52	4	120 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	0	60 h	60 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	7	SPO 1 / 2023

Competence-based requirements for participation	
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)		SP	
	Submodule exam (MTP)			
Calculation of the final grade	☐ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	- Courses totalling 4 ECTS credits can be freely selected from the Studium generale catalog of the HTWG Konstanz and the University of Konstanz. - This offer is intended to enable and encourage students to take a closer look at related subject areas or to deepen their interests in an area unrelated to the subject.

Teaching and learning methods	☐ Lecture ☐ Practice ☐ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: Depending on the chosen courses

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Selection from Studium Generale Prof. Dr.-Ing. C. Nied / Dozent*innen der Hochschule	X		4	

Literature			
Language	German/English	**Last update**	02.02.2024

Module 14	**Machine Dynamics**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Lege	SS, WS	MO 14	5	150 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	4	60 h	90 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	3	SPO 1 / 2023

Competence-based requirements for participation	Technical Mechanics
Usability in above-mentioned program	Prerequisite for: Recommended in combination with:

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	K90		
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students know the basics of dynamics, in particular the calculation of accelaration, speed and forces or moments of moving objects - They are able to aply this knowledge to engineering problems and thus determine dimensions for the design of components and drives. **Methodological competencies** - The students will learn to model real systems, in particular systems that have to be described physically and mathematically with differential equations. - They will learn to interpret them and to solve or simulate them with respect to selected problems **Personal competencies** - The students will understand how dynamics (subject of this module) and statics, strength of materials theory and drive technology, as well as design technology (contents of related modules) are interlinked in order to design machines or components in a functionally appropriate manner. - Some of the examples examined concern future-oriented technologies, e.g. from electromobility or experimental transportation systems (e.g. Hyperloop), thus broadening the students' knowledge horizon.

Teaching and learning methods	☒ Lecture ☒ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☐ Others:

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Machine Dynamics Prof. Dr. B. Lege		4	5	- Basic concepts - Kinematics in Cartesian coordinates and polar coordinates - Moment of inertia - Kinetics, in particular Newton's laws - Modeling of systems with one degree of freedom with differential equations - Modeling systems with multiple degrees of freedom with differential equations - Solving these problems with various constraints

Literature	- Engineering Mechanics: Dynamics / Hibbler, Russel C., Pearson, 2016, ISBN: ISBN: 978-1-292-08878-5		
Language	${mo.language}	**Last update**	02.02.2024

Module 53	**Project**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr.-Ing. C. Nied	SS, WS	MO 53	12	360 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	1	15 h	345 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	7	SPO 1 / 2023

Competence-based requirements for participation	Depending on the content, selected courses of the entire degree programme
Usability in above-mentioned program	Prerequisite for: Recommended in combination with: Bachelor thesis

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	S		R
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students can solve practical engineering problems independently and in a structured manner using scientific methods. - They are able to use the acquired specialist knowledge in a targeted manner. **Methodological competencies** - The students can organise and structure complex, holistic topics/ problem areas. - They work in a goal-oriented and solution-oriented manner on a topic of their choice. - They know how to structure an engineering paper in a meaningful way and learn to formulate facts precisely. - They can find and cite relevant literature. **Personal competencies** - The students are able to apply key competencies in the areas of time management, learning and work techniques in a targeted manner.

Teaching and learning methods	☐ Lecture ☐ Practice ☒ Self-study ☐ Workshop/Seminar ☒ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: Final report

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Project Prof. Dr.-Ing. C. Nied	PJ	1	12	

Literature			
Language	German/English	**Last update**	02.02.2024

Module	**Bachelor Thesis**			
Module coordination	**Start**	**Module code/no.**	**ECTS-points**	**Workload**
Prof. Dr. B. Böck	SS, WS	MO BA	12	360 h
	Duration	**SWS**	**Contact hours**	**Self-Study hours**
	1 Semester	0	15 h	345 h

Usability in programs	**Intended degree**	**Type of module (compulsory PM/elective WPM)**	**Semester of study**	**SPO-version / year**
SET	B.Eng.	PM	7	SPO 1 / 2023

Competence-based requirements for participation	Modules of the study semesters 1 to 5 mandatory. Modules of semesters 6 and 7 recommended. Module MO 51, Scientific Writing, mandatory
Usability in above-mentioned program	Prerequisite for: Recommended in combination with: Project

Method of evaluation		**Graded exam**	**Ungraded exam**	**Ungraded performance record**
	Module exam (MP)	S		R
	Submodule exam (MTP)			
Calculation of the final grade	☒ Grade of the graded module (part) examination ☐ ECTS-weighted arithmetic mean of the graded module part examinations ☐ Others:			

Learning objectives	**Subject-specific competencies** - The students are able to work on a problem in their field independently and according to scientific methods and findings within a given period of time. - They have in-depth professional knowledge and competencies in the subject area of their bachelor thesis. **Methodological competencies** - The students can quickly familiarize themselves with and structure new topics on the basis of their specialist and fundamental knowledge. - They can document and present topics from their subject area in a comprehensible manner. - They can discuss complex subject-related problems and solutions in a well-founded manner and represent them argumentatively. **Personal competencies** - Students are able to apply key competencies in the areas of time management, learning and work techniques in a targeted manner. - They will master the application of project management methods to projects of manageable scope.

Teaching and learning methods	☐ Lecture ☐ Practice ☒ Self-study ☐ Workshop/Seminar ☐ Project ☐ Laboratory ☐ Excursion ☐ E-Learning ☐ Term paper ☐ Intensive language course ☒ Others: Bachelor Thesis

Submodule Lecturer	**Type**	**SWS**	**ECTS**	**Teaching content**
Bachelor Thesis Prof. Dr. B. Böck			12	

Literature			
Language	German/English	**Last update**	01.02.2024