HSBI

Hochschule
Bielefeld
University of
Applied Sciences
and Arts

Study Programme Examination Regulations (*Studiengangsprüfungsordnung* – SPO) For the bachelor's degree programme "Mechatronics and Automation" at HSBI

as of 15 August 2025

Note:
The English version is provided for readability purposes only. The German version of the examination regulations is legally binding.

Pursuant to Section 22(1) no. 3, Section 2(4) and Section 64(1) of the Higher Education Act of the State of North Rhine-Westphalia (*Hochschulgesetz* – HG) of 16 September 2014 (GV. NRW p. 547), as last amended by Article 2 of the Act of 5 December 2023 (GV. NRW p. 1278) in conjunction with the General Examination Regulations (BA-RPO) for Bachelor's and Master's Degree Programmes at Hochschule Bielefeld University of Applied Sciences and Arts of 1 October 2024, the Faculty of Engineering and Mathematics at HSBI has issued the following Study Programme Examination Regulations:

§ 1

Scope of the Study Programme Examination Regulations

These Study Programme Examination Regulations apply to the bachelor's degree programme "Mechatronics and Automation" at HSBI. In addition, the provisions of the General Examination Regulations for Bachelor's and Master's Degree Programmes of HSBI in its respective valid version shall apply, unless these regulations stipulate different provisions according to Section 1(3) of the General Examination Regulations.

§ 2

Provisions Specific to the Study Programme

1.	Academic Degree	Following successful completion of the bachelor examination, HSBI awards the academic degree "Bachelor of Engineering" (B.Eng.) in the study programme "Mechatronics and Automation".
2.	Qualification Objectives	In accordance with Section 58 HG, the studies leading to the bachelor examination are intended to enable students to explore theoretical content in engineering and mathematics, to analyse related processes and problems, and to develop independent solutions that also take extracurricular contexts into account. The studies enhance students' existing qualifications by means of interdisciplinary learning content. They are designed to develop the students' creative and planning skills and prepare them for the bachelor examination. During their studies, students acquire the ability to work scientifically through intensive contact with scientific literature as part of their self-study. Theoretical foundations are imparted in a scientifically prepared form, enabling students to engage with the material independently and to undertake research that supplements the content directly provided. In this way, students are prepared to process academic material and to progress to the Project 1 and 2, the internship, and ultimately the bachelor thesis, independent of a specific course offering. Based on the three main pillars of electrical engineering/mechatronics, mathematics and technology/technical informatics, graduates of the Mechatronics degree programme possess the competence to develop embedded systems for the control and monitoring of mechatronic systems, as well as to apply automation systems for the control of industrial plants and production

		processes. They are capable of comprehending innovations arising from science and research and of contextualising them with regard to specific system requirements. Supplementary to Section 3 (2) of the RPO, the ability to work as an engineer is taught as part of the Mechatronics and Automation degree programme. This means that students are able to define and analyse technical issues and develop, plan and specify corresponding solution concepts. They have used methods and techniques to learn and solve new tasks. Graduates 1. Are able to apply scientific findings and methods independently and in a practice-oriented manner when developing automation systems. 2. Are able to determine the function, properties and quality requirements for a specific system and to implement them sustainably. 3. Have learned to think in an interconnected manner across mechanics, electrical engineering, and software technology and to take the system synthesis into account integrative and holistically with particular consideration of control technology. 4. Can assess complex issues and have learned to generate different requirements and system solutions across organisational boundaries. 5. Are able to interpret these systems' business evaluations (e.g. calculation, marketing). 6. Are able to relate principles of self-management and learning and problem-solving techniques to strategies of project management and teamwork. 7. Are able to work in a problem-oriented, interdisciplinary manner using their social skills, both independently and in a team. 8. Are able to formulate and present technical solutions and perspectives and discuss these with professional representatives as well as with experts from other disciplines. 9. Are able to independently enhance their acquired expertise and critically assess its relevance and application in solving problems.
3.	Admission Requirements	Admission to the bachelor's degree programme requires proof of a university entrance qualification in accordance with Section 49 HG NRW. Further requirements are set out in HSBI's *Einschreibungsordnung* (enrolment regulations) in its currently valid version. In addition, applicants must provide proof of English skills at level B2 CEFR. Proof can be provided through a certificate from a state or state-recognised school or university that explicitly shows English skills at least at level B2 CEFR. In addition, the following documents and certificates are recognised: 1. IELTS: score of at least 5.5, 2. TOEFL (IBT): score of at least 72, 3. TOEFL (PBT): score of at least 543, 4. TOEFL (ITP): score of at least 543, 5. Telc B2 certificate,

		6. UNIcert II, 7. Cambridge FCE First Certificate in English, 8. Cambridge English Qualification: score of at least 160. Applicants with an English-taught university or high-school degree can provide proof of their English language skills with a document provided by their school or university stating that the language of instruction was English. One or more authorised faculty members decide on the recognition of other proof.
4.	Beginning of Studies	Studies start in the winter semester of each year.
5.	Standard Time to Degree	The standard time to degree is seven semesters.
6.	Number of Required Credit Points	A total of 180 credits must be achieved in the seven-semester programme.
7.	Composition of Credit Points	The modules offered are all compulsory. The programme's qualification goal is based on the compulsory modules. The compulsory modules specified in the programme structure must be completed. Additional modules are modules that can be completed beyond the scope specified in the programme structure. Additional modules shall not be considered in the calculation of the overall grade and are excluded from the bachelor examination results; they will be documented separately in the degree certificate. Courses are usually offered annually, so adherence to the programme structure is strongly recommended.
8.	Workload per Credit Point	The workload for a credit is 30 hours.
9.	Considered Individual Notes for the Overall Grade	In order to determine the overall grade for the bachelor's degree study, the grades for each graded examination are multiplied by the respective credit points reported. The sum of the weighted grades is then divided by the total number of credit points included. The bachelor examination is considered passed when 180 credit points are reached. The bachelor examination is considered failed if the overall grade is not at least "sufficient" (4.0) or if the bachelor thesis is not considered passed in the second attempt or is considered failed.
10.	Weighting of Individual Grades for the Overall Grade	According to RPO
11.	Registration for Examinations	Examinations accompanying the studies should take place at the time when the respective module is completed. Students will automatically be registered for the regular examination dates of all module examinations they have to take. Deregistration from a module examination is only possible in the event of illness or a comparable inability to attend that cannot be avoided. Proof of the inability to attend must be submitted. A prerequisite for compulsory registration after resumption of studies is that the student has had the opportunity to participate fully in the courses that end with these module examinations. This is generally the case if the student was enrolled for the full duration of these courses.

12.	Compensation of Examinations	Examination results are not subject to compensation.
13.	Repeat Attempts for Failed Module Examinations	A failed module examination can be repeated twice. The repeat should take place on the next examination date after the unsuccessful attempt has been completed. For each repeat examination, students will automatically be registered for the next possible re-examination date after they have failed an examination. Deregistration from a repeat examination is only possible in the event of illness or a comparable inability to attend that cannot be avoided. Proof of the inability to attend must be submitted. Module examinations are held at the end of the lecture period in which the module was offered. Repeat examinations are regularly offered within the lecture period following the regular examination date. The bachelor thesis can only be repeated once. Students must repeat examinations that they missed due to illness or a comparable unavoidable inability to attend at the next possible examination date.
14.	Repetition of Passed Module Tests to Improve Grades	An examination graded at least "sufficient" cannot be repeated.
15.	Scope of the Bachelor Thesis	The bachelor thesis constitutes a written paper that investigates an engineering problem and provides a comprehensive description and justification of the proposed solution. The work may be based on empirical research, conceptual or design tasks, or the evaluation of existing literature and sources. A combination of these methods is possible. The bachelor thesis should not exceed 45 pages of text in length. The registration of the bachelor thesis (request for admission) is to take place before the start of the seventh semester. The subject of the bachelor thesis can already be determined with the student in advance. Admission to the bachelor thesis is open to all those who have passed all except for five module examinations. The request for admission may be withdrawn in writing until the decision on the request has been made without counting towards the number of possible examination attempts.
16.	Processing Time for BA Thesis	The processing time for a BA thesis is at no less than eight weeks and no more than 12 weeks.
17.	Length of Colloquium	Colloquiums are not required.
18.	Evaluation of Colloquium	Colloquiums are not required.

§ 3

Programme Structure and Modules

(1) Programme structure: the course schedule in Appendix 1 contains the programme structure, including workload, scope of the individual modules in credit points and weekly hours per semester, type of course and the recommended time at which the course should be taken during studies as well as the modules and other coursework to be completed.

(2) Modules: The module descriptions in Appendix 2 contain the module number, content, credit points, admission requirements, forms of assessment and requirements for passing the module and module examinations.

§ 4

Special Provisions

(1) Special Forms of Assessment

a. Term Paper:
Term papers are written papers that usually do not exceed 20 pages and are produced as part of a course or in connection with a project work that they accompany. Depending on the requirements of the lecturer, they can be supplemented by an expert presentation of 15 to 45 minutes. For the expert presentation, Section 19(2)–(5) RPO shall apply. The term paper must be submitted to the lecturer within a deadline determined by the lecturer.

b. Project paper:
The project work comprises a written paper and an oral presentation.

- A project is a task (if possible, an interdisciplinary task) that is planned and selected by the lecturer in collaboration with the students. It is conducted as independently as possible, with advice from the lecturers. The projects deal with specific problems holistically under practical conditions. In group projects, the lecturer distributes the content of the work among the students in fair shares.
- A student's individual examination performance will be assessed by the responsible lecturer after the end of the respective semester according to the criteria below:
    1. Documentation,
    2. Presentation by the individual student,
    3. If applicable, contribution to the team result in a group project,
    4. If applicable, team skills.

    The results are recorded in a list.
- The examination component of the project work is conducted as an oral presentation of 30 to 45 minutes. In the case of group projects, all

students involved in the respective project must present their individual contributions and results. The oral presentation takes place in the presence of the lecturer who supervised the project work. For the oral presentation, Section 19 RPO (2)–(5) shall apply.

- The written paper must be submitted to the examiner at least one week before the oral presentation.

c. Performance examination:
In appropriate cases, a module examination can be taken in the form of a performance examination.
    - A performance examination consists of a theoretical and a practical part. The overall grade is derived as an arithmetic average from the grades of the individual performances according to a previously determined weighting system. The examination usually lasts no more than 60 minutes.
    - The performance examination is usually developed by only one examiner and taken in the presence of one or more expert assessors or several examiners.

d. Course Assessment/Certificate of Successful Participation ("Testat")
A study achievement consists either of the participation in specific courses or of an individually identifiable performance (course assessment/"Testat"), which is made alongside a course and whose subject and requirements relates to the content of the respective course. Regular lecture attendance, active participation in seminars, active participation in exercises, presentations, drafts or internship reports, etc. can be considered course assessments. The form is individually determined by the lecturer responsible for the course and announced at the beginning of the course.
    - Course assessments are only rated as "passed" or "failed." Failed course assessments can be repeated an unlimited number of times.
    - The respective lecturer is responsible for the decision whether a certificate of successful participation is awarded or not. The results must be communicated to the students and the examination office.
    - The certificate may be a prerequisite for participation in the examinations (preliminary examination).

(2) Final Examination in Design Programmes

(3) Special Study Elements

a. Practical Project/Internship

- The mandatory practical project/internship in the sixth semester includes a practical work placement at a company with a workload of 6 credits or 180 hours. This practical project/internship allows for more time-intensive training in practical tasks.
- The practical project / internship is scheduled for the lecture-free period of the sixth semester but may, upon a student's request and with the lecturer's approval, be completed during the lecture-free period of an earlier semester.

- The practical project / internship is subject to the legal regulations that HSBI as a corporation under public law must observe as a whole.
- The practical project / internship is intended to introduce students to their professional activities through concrete tasks and practical work in the company providing training. In particular, it allows them to apply the knowledge and skills acquired during their previous studies and reflect on and evaluate experience gained performing practical activities.

b. Company suitability
Any company whose tasks permit the employment of engineers is potentially suitable as a company providing training. There must be employees in the company whose qualifications make them suitable supervisors for the students during the work term. Companies must be able to guarantee work experience in line with the objectives of the practical project / internship.

c. Contract for the practical project / internship
Unless an employment relationship already exists, the company providing training and the student will conclude a contract for the practical project / internship .

d. Supervision of students during the practical project / internship
During the practical project / internship, students are supervised by a lecturer. The students provide the lecturer with an insight into the work they perform at least once during the practical project / internship .

§ 5

Final Provisions

(1) In derogation from Section 18(4) of the Digital University Ordinance (*Hochschuldigitalverordnung* – HDVO), provisions concerning digital examinations based on these regulations do not require the approval of the study committee.

(2) These Examination Regulations shall be announced in the Announcement Bulletin of HSBI – Official Notices ("Verkündungsblatt der Hochschule Bielefeld – Amtliche Bekanntmachungen"). They shall enter into force one day after their publication.

Please note that pursuant to Section 12(5) of the Higher Education Act of North Rhine-Westphalia (*Hochschulgesetz* – HG NRW), a violation of procedural or formal requirements of the regulatory or other autonomous law of the university can no longer be asserted after the end of one year since this announcement, unless

1. The regulations have not been properly announced,
2. The Executive Board has previously objected to the decision of the committee which has resolved upon the regulations,
3. The university has been reprimanded for the defect in form or procedure in advance, identifying the violated legal provision and the fact that results in the defect, or
4. The legal consequence of the exclusion of reprimands was not pointed out in the public announcement of the regulations.

Issued on the basis of the decision of the Faculty Council of the Faculty of Engineering and Mathematics at HSBI of 12 March 2025.

Bielefeld, 15 August 2025

The President

of HSBI

Prof. Dr. Ingeborg Schramm-Wölk

Programme Structure

for the bachelor's degree programme "Mechatronics and Automation" (MAU)

First semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3423	Basics of Computer Science	BCS	2	1	0	1	4	5
3375	Future Technologies & Sustainability	FTS	1	1	0	2	4	5
3378	Mathematics I	MATHS 1	2	2	0	0	4	5
3424	Basics of Business Administration	BBA	2	2	0	0	4	5
3407 or 3376	Introduction to German Culture & Language/Intercultural Communication	ICGL / ICM	2	2	0	0	4	5
						Total:	20	25
Second semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3421	Electrical Engineering I	EEN1	2	2	0	0	4	5
3382	Innovation & Project Management	IPMN	2	2	0	0	4	5
3383	Mathematics II	MATHS 2	2	2	0	0	4	5
3381	Physics	PHS	2	1	0	1	4	5
3409	Object Oriented Programming	OOP	2	1	0	1	4	5
						Total:	20	25
Third semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3422	Electrical Engineering II	EEN2	2	1	0	1	4	5
3386	Databases	DBS	2	2	0	0	4	5
3385	Engineering Mechanics – Statics and Strengths of Materials	EMSM	2	1	0	1	4	5
3410	Digital Electronics	DET	2	2	0	0	4	5
3411	Mathematics III	MATHS 3	2	2	0	0	4	5
						Total:	20	25
Fourth semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3412	Electrical Measurement Technology	EMT	2	1	0	1	4	5
3413	Engineering Mechanics – Kinematics and Kinetics	EMKK	2	1	0	1	4	5

[1] for students with a German university entrance qualification: "Intercultural Communication (ICM)", for students with a university entrance qualification obtained abroad: "Introduction to German Culture & Language (ICGL)"

3414	Semiconductor Devices and Circuits	SDC	2	1	0	1	4	5
3387	Statistics	STAS	2	2	0	0	4	5
1407	Project 1	PRIN1	0	0	0	0	0	6
						Total:	16	26
Fifth semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3408	Basics of Mechanical Design	BMD	2	2	0	0	4	5
3393	Industrial Automation Technology	IAT	2	1	0	1	4	5
3415	Electrical Machines	ELM	2	1	0	1	4	5
3416	Measuring Systems and Sensor Technology	MUSE	2	1	0	1	4	5
1408	Project 2	PRIN2	0	0	0	0	0	6
						Total:	16	26
Sixth semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3396	Control Technology	CTG	2	1	0	1	4	5
3417	Mechatronic Systems I	MSE1	2	2	0	0	4	5
3399	Microcontroller Programming	MPM	2	1	0	1	4	5
3418	Power Electronics	PET	2	1	0	1	4	5
1406	Practical Project/Internship	PPI	0	0	0	0	0	6
						Total:	16	26
Seventh semester			L	SL	E	P/S	∑	cps
Module number	Module title	Module ID						
3406	Bachelor thesis	BTHS	0	0	0	0	0	12
3419	Mechatronic Systems II	MSE2	2	2	0	0	4	5
3402	Industrial Communication	ICM	2	1	0	1	4	5
3420	Drive Technology	DTN	2	1	0	1	4	5
						Total:	12	27
						Total:	120	180

Abbreviations of the teaching forms: V = lecture, SU = seminar-based teaching, Ü = exercise, S = seminar, P = practical project or internship, bS = supervised self-study (all information provided in semester hours per week);
CP = credit points
W/S = winter/summer semester

Module Catalogue

for the bachelor's degree programme "Mechatronics and Automation" (MAU)

Bachelor thesis					**BTHS**
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:
3406	360	12	7th semester	Each semester	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/classroom teaching		Self-study:	
	Lecture	60 students	0	weekly hours	0	h	360	h
	Seminar-based teaching	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences:	
	After successfully completing the bachelor thesis, students are able to independently work on and appropriately present a practice-oriented task from their special subject area, both in the subject-specific details and in the interdisciplinary contexts, using scientific methods within a specified period of time.	
3	Contents:	
	The bachelor thesis is an independent scientific work from the subject area of the respective study programme with a description and explanation of its solution. It can be derived from current research projects at the university or from operational problems with an engineering character. It can also be carried out through an empirical investigation or through conceptual or design tasks or through an evaluation of existing sources. A combination of these is possible.	
4	Forms of teaching:	
	Written composition with faculty tutoring	
5	Participation requirements:	
	Formal:	None
	Content:	Coordinated topic from the student's special subject area
6	Forms of assessment:	
	Bachelor thesis	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes):	
	Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	according to RPO	
10	Module coordinator:	
	Vice – Dean for Study and Teaching of the Department of Engineering and Mathematics	
11	Other information:	

12	Language: English

Basics of Business Administration									BBA
ID number:		Workload:	Credits:	Semester:			Frequency of the offer:		Duration:
3424		150	5	1st semester, 3rd semester or 7th sem.			Annual (winter)		1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	2	weekly hours	30	h	45	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: The students know the basic organisational structures and the optimisation tasks of companies as well as the basic principles and success criteria of economic action. This enables them to classify their own engineering activities in the operational and business context and to assess and control the economic consequences/effects of their activities. In this sense, the module provides the basic business knowledge and the basic structures for interdisciplinary thinking and acting.
3	Contents: • Classification, development and basic concepts of business administration • Basic principles of economic action • Overview of the most important business functions (procurement, production, logistics, human resources management, marketing) • Corporate goals and corporate key figures/indicator systems • Fundamentals of business accounting and cost accounting • Forms of corporate law and corporate affiliations
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons
5	Participation requirements: Formal: - Content: -
6	Forms of assessment: Term paper, written examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to BRPO
	Module coordinator:

10	Prof. Dr. rer. pol. Mariam Dopslaf
11	Other information: -
12	Language: English

Basics of Computer Science									BCS
ID number:		Workload:	Credits:	Semester:			Frequency of the offer:		Duration:
3423		150	5	1st semester			Annual (winter)		1 semester
1	Course:		Planned group sizes:	Scope:			Actual contact time/ classroom teaching		Self-study:	
	Lecture		60 students	2	weekly hours		30	h	45	h
	Sem. lessons		30 students	1	weekly hours		15	h	22.5	h
	Exercise		20 students	0	weekly hours		0	h	0	h
	Practical or seminar		15 students	1	weekly hours		15	h	22.5	h
	Supervised self-study		60 students	0	weekly hours		0	h	0	h
2	Learning outcomes/competences:									
	After successful completion of the module, students can explain important terms of Computer Science and their interrelations. They can describe the basic functioning of computer systems and computer architectures. Students know selected methods for describing and evaluating algorithms and can apply them to new problems. They can structure simple information technology problems and develop suitable solutions, as well as justify and defend them. Students have basic knowledge and initial experience in the implementation of algorithms in the programming language C.									
	Contents:									

3	Introduction to Computer Science: • Terms and definitions • Number systems (in particular decimal, binary and hexadecimal system) • Representation of numbers and characters in the computer • Methods for describing algorithms with flow charts and pseudocode • Methods for evaluating the complexity of algorithms Basics of computer architecture: • Basic structure of processors • Memory hierarchy • Bus systems Programming in C: • Data types and variables • Conditional instructions • Loops • Functions • Arrays • Pointer and pointer arithmetic • Preprocessor instructions • Structures and enumerated data types • Working with files • Dynamic memory allocation Selected algorithms: • Sorting algorithms (e.g. bubble sort and quick sort) • Search algorithms (e.g. binary search)	
4	Forms of teaching:	
	Classroom teaching in the form of lectures, seminar lessons and practicals	
5	Participation requirements:	
	Formal:	
	Content:	
6	Forms of assessment:	
	Written exam or project work	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes):	
	Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	according to RPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Christian Stöcker	
11	Other information:	
12	Language:	
	English	

Basics of Mechanical Design					BMD
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3408	150	5	3rd or 5th semester	Annual (winter)	1 semester

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

2 Learning outcomes/competences:

On successful completion of the module, students are able to ...

- Explain and apply the design process and its methods.
- Apply design rules, principles and guidelines in the design process and develop optimised designs with regard to load, material, production, sustainability, diversity aspects, recycling and maintenance.
- Create schematic diagrams and perform analytical calculations.
- Create and interpret technical drawings and explain how to handle tolerances, fits and technical surfaces.
- Can categorise computer-aided tools such as CAD, CAE or AI tools in the design process.
- Understand and use the purpose and function of machine elements (connecting, bearing and transmission elements, guides, axles and shafts, etc.) in mechanical systems.
- Explain the principles and techniques of production technologies according to DIN 8580 (forming, shaping, machining, cutting, coating, changing material properties) and select the correct procedure for specific tasks.
- Apply the basics of additive manufacturing.
- Apply their knowledge to practical design tasks and develop a product concept.

Contents:

1. Introduction to construction design:
   - Understanding the design process and its methods
   - Differentiating different types of designs
   - Applying product development methods
2. Requirements and design rules in construction design:
   - Applying design principles, rules and guidelines to designs
   - Developing designs that are optimal in terms of sustainability, diversity, load, material, production, maintenance, etc.
   - Designing clear, simple and secure systems
3. Tools and techniques in the design process:
   - Creating schematic diagrams and performing analytical calculations

	• Applying technical drawings and understanding tolerances, fits and technical surfaces • Using computer-aided tools such as CAD, CAE or AI in the design process 4. Use and understanding of machine elements: • Understanding fasteners, bearing and transmission elements in machines • Recognising guides, axles and shafts in mechanical systems 5. Overview of production techniques: • Understanding forming and shaping in production technology • Knowledge of machining and joining processes • Insight into additive manufacturing technology	
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Term paper, written examination or oral examination	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Maik Lauterbach	
11	Other information:	
12	Language: English	

Control Technology					CTG
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:
3396	150	5	6th semester	Annual (summer)	1 semester

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

2 Learning outcomes/competences:

After successful completion of the course, the students will be able to assign the basics from the field of control technology. The students are able to recognise the benefits of control systems in a problem-oriented manner and develop solution strategies. In addition, the students can solve simple control engineering tasks, i.e. find the corresponding controllers and their parametrisation for simple technical processes. Students can resolve and simplify more complicated control engineering structures. In addition, the students can predict the behaviour of the closed control loop on the basis of a mathematical circuit model. In small groups, the students have gained initial experience with the design and implementation of simple controls for simple processes and
have implemented and tested them using common simulation software such as MATLAB Simulink.

3 Contents:

Introduction to Control Engineering

- Terms
- Definitions
- Block diagrams

Transmission link analysis

- Steady-state and dynamic behaviour
- Frequency response and floor diagram
- Determining mathematical models for technical systems

The control loop

- Basic structure of the control loop
- Control loop structures
- Stability behaviour of control loops
- Classical linear controllers
- Simple design procedures
- Parameter-optimal controls

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	Term paper or written examination or project work or oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes):	
	Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	According to RPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Christian Stöcker	
11	Other information:	
12	Language:	
	English	

Databases					DBS
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3386	150	5	3rd sem.	Annual (winter)	1 semester

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

2 Learning outcomes/competences:

On successful completion of the course, students

- Acquire basic knowledge about the architecture, functioning and use of database systems and know the principles of the organisation of a database system.
- Acquire knowledge of data modelling, including the importance of normalisation rules.
- Are able to carry out a complete relational database design, starting from a requirements specification.
- Are able to implement a relational database schema using SQL.
- Are proficient in standard SQL to perform simple and complex queries, as well as change operations.
- Are able to manage access rights and users, as well as implement triggers and procedures.
- Are able to plan and implement database projects.

3 Contents:

- Basics of databases
- Database design (Entity Relationship Model (ERM))
- Relational model (RM) (transformation ERM to RM, functional dependencies, normalisation, relational algebra)
- Database language SQL (Structured Query Language), Creating/modifying/deleting databases, tables and views, inserting/modifying/deleting data (Data Manipulation Language (DML), Data Definition Language (DDL)), and creating complex queries (Data Query Language (DQL))
- Access rights and user management (Data Control Language (DCL))
- Procedures and triggers
- Looking at NoSQL databases

4 Forms of teaching:

Classroom teaching in the form of lectures and seminar lessons

5 Participation requirements:

Formal:	None
Content:	None

6	Forms of assessment: Written examination, project work or oral examination or a combination of project work and oral examination
	Prerequisite for the award of credit points:
7	Module examination pass
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr. rer. nat. Alexander Maier
11	Other information:
12	Language: English

Digital Electronics									DET
Identification number:	Workload:	Credits:	Study semester:			Frequency of the offer:			Duration:
3410	150	5	3rd sem.			Annual (winter)			1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	2	weekly hours	30	h	45	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences:
	Students are familiar with the basics of analysing and designing simple digital circuits. They present the basic relationships from the field of digital technology and classify them in the context of control technology. The students can develop simple digital circuits to solve control engineering tasks from the various technical areas. Students analyse digital circuits and apply theoretical (e.g. Boolean algebra) and algorithmic procedures (e.g. QMC) for simplification. They are able to identify the benefits of digital systems in a problem-oriented manner and to select and develop solution approaches and strategies. Furthermore, they can justify and defend their solution to a given digital technology problem. The students know the basics of programmable logic circuits and FPGAs and their text-based description with selected hardware description languages.
	Contents:

3	Introduction to digital technology • Terms • Definitions • Number systems • Codes and coding Analysis and synthesis of circuits • Basic and derived links • Calculation rules of circuit algebra • Description of logical functions • Simplification of logical circuits • Switchgear of the code converter • Bistable and monostable tilting stages • Delay elements • Astable tilt steps • Hazard ratio calculator • Asynchronous and synchronous counters • Design methodology for Programmable Logic Devices (PLD) • Introduction of PLDs • Programming PLDs • FPGAs • Hardware description languages	
4	Forms of teaching: Classroom teaching in the form of lectures, seminar lessons and practicals	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Written examination or oral examination or a combination of written examination and oral examination	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr. rer. nat. Alexander Maier	
11	Other information:	
12	Language: English	

Drive Technology									DTN
Identification number:		Workload:		Credits:		Study semester:		Frequency of the offer:	Duration:
3420		150		5		7th semester		Annual (winter)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h
2	Learning outcomes/competences:							
	After successful completion of the course, the students have understood the functional principle of a stepper motor and can explain the functionality in their own words. The students worked in small groups to understand the control principle of a stepper motor and gained their first practical experience in programming a control circuit for a stepper motor. The students have understood the functional principle of a frequency inverter as well as a servo amplifier including servo motor and can describe the function in their own words. In addition, the students have gained a basic understanding of the design, adjustment and parameterisation of a drive. The students have gained their first experience in the programming of function control applications and have implemented and practically tested their own programmes using common programming software.								
	Contents:								

3	Stepper motor • Design and operating principle • Control and adjustment Frequency inverter and servo amplifier • Rectifier • DC link • Pulse inverter • Modulation method • Communication interfaces to position encoders • Current measurement • Voltage measurement Design, setting and parameterisation of drives • Design of a drive • Setting and parameterisation of drives Motion Control • Introduction • PLC Motion Programming • CNC programming with G-code • Kinematics Servo motors • Structure • Holding brake • Position transmitter	
4	Forms of teaching: Classroom teaching in the form of lectures, seminar lessons and practicals	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Written exam, project work or oral exam	
7	Prerequisite for the award of credit points: Module examination pass and course assessment	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Michael Leuer	
11	Other information:	
12	Language: English	

Electrical Engineering I					EEN1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:
3421	150	5	2nd sem.	Annual (summer)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	2	weekly hours	30	h	45	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the module, students are able to:

- Define and explain the basic terms and items of electrical engineering.
- Describe Ohm's law and its application in DC circuits.
- Explain structure and types of resistors and capacitors.
- Explain the basic principles of sustainability in electrical engineering.
- Analyse and interpret the physical relationships in electricity.
- Understand the function of semiconductor devices in DC circuits.
- Understand the importance of energy-efficient design and sustainable use of materials in electrical engineering.
- Calculate and analyse simple and branched DC circuits.
- Analyse and calculate electrostatic fields and forces.
- Use capacitors in charging and discharging processes.
- Use resistors and capacitors in the circuit.

Contents:

3	DC technology • Fundamentals of electrical flow • Introduction to Electrical Engineering • Electrical charges • Power • Voltage • Work, power, energy conversion efficiency • Calculation of direct current circuits • Networks, two-terminal networks • Kirchhoff rules • Series and parallel circuit • Method of calculating DC circuits • Condenser and coil • Nonlinear direct current circuits The electric field • Introduction • Charge separation, isolator, conductor • Induction • Charge • Coulomb's law, superposition principle • The E field
	• Field lines • Peak effect and surface charge density • The plate capacitor • Conductors and insulators in the E-field
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination or oral examination or a combination of written examination and oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr.-Ing. Maik Lauterbach
11	Other information:
12	Language: English

Electrical Engineering II					EEN2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:
3422	150	5	3rd sem.	Annual (winter)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the module, students are able to ...

- Analyse and interpret the physical relationships of electricity and magnetism.
- Independently solve simple tasks related to magnetic fields.
- Describe the static and time-varying magnetic field and explain its effects.
- Apply Faraday's induction law and the principles of inductance.
- Understand how transformers work and use them in different applications.
- Understand and apply basic concepts and principles of alternating current technology.
- Understand and calculate demanding circuits from the AC range based on the complex calculation.
- Describe AC variables with the aid of complex calculation and calculate AC circuits for different applications.
- Apply the principles of power in an AC circuit.
- Assess complex issues and generate different requirements and system solutions that aim at sustainability and energy efficiency.

Contents:

3	The magnetic field • The static and time-variant magnetic field • Calculation of magnetic circuits • Induction laws and inductance • The transformer: function, working principle and applications AC technology • Basic concepts of alternating current technology • Description of alternating variables with the aid of complex calculation • Procedure for calculating alternating current circuits • Behaviour of components in the AC circuit • Power in AC circuit • Construction and designs of coils and transformers • Electrical engineering applications for the development of sustainable and energy-efficient automation systems	
4	Forms of teaching: Classroom teaching in the form of lectures, seminar lessons and practicals	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Written examination or oral examination or a combination of written examination and oral examination	
7	Prerequisite for the award of credit points: Module examination pass and course assessment	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Maik Lauterbach	
11	Other information: -	
12	Language: English	

Electrical Machines									ELM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:				
3415	150	5	5th semester	Annual (winter)	1 semester				

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

After successful completion of the course, the students have understood the functional principle of the DC motor, the three-phase synchronous motor and the three-phase asynchronous motor. The students can describe the function of the respective motor types in a few words and describe the steady-state operating behaviour using the steady-state motor equations they have worked out. In addition, the students can select suitable operating points for controlling the motor.
The students practically tested and evaluated the operating behaviour of a DC motor in small groups. In addition, the students worked in small groups to understand the functional principle of an inverter for controlling a three-phase motor They implemented the control programme for a pulse inverter in a common programming environment, tested it on a three-phase motor and evaluated it.

Contents:

3	Introduction to drive technology • Tasks of drive technology • Basic structure of an electric drive • Materials for building electric motors • Cooling of electrical drives • Losses in electrical drives Basic electrotechnical laws • Flow law • Induction law • Force action law DC motor • Design and operating principle • Modelling • Stationary operating behaviour • Operation on a buck converter • Inverter circuit • Pulse width modulation Synchronous motor • Design and operating principle • Modelling • Stationary operating behaviour and operating point selection Asynchronous motor • Design and operating principle • Modelling • Operating behaviour	
4	Forms of teaching:	
	Classroom teaching in the form of lectures, seminar lessons and practicals	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	Written examination or project work or oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes):	
	Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	according to RPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Christian Stöcker	
11	Other information:	
12	Language:	
	English	

Electrical Measurement Technology										EMT
Identification number:		Workload:		Credits:		Study semester:		Frequency of the offer:		Duration:
3412		150		5		4th semester		Annual (summer)		1 semester
1	Course:		Planned group sizes:		Scope:			Actual contact time/ classroom teaching		Self-study:	
	Lecture		60 students		2	weekly hours		30	h	45	h
	Sem. lessons		30 students		1	weekly hours		15	h	22.50	h
	Exercise		20 students		0	weekly hours		0	h	0	h
	Practical or seminar		15 students		1	weekly hours		15	h	22.5	h
	Supervised self-study		60 students		0	weekly hours		0	h	0	h
2	Learning outcomes/competences:										
	Students are able to carry out metrological tasks in electrical engineering. They can calculate reliable parameters from linked measurement series in order to derive conclusions for measurement reliability. They can detect measurement errors and describe them mathematically. They master important rules of error calculation, including for several dependent variables. They know the structure and application of the devices required for measuring technology.										
	Contents:										

3	Contents: • Basic concepts and their significance in electrical measurement • Measurement of basic electrical quantities (current, voltage and resistance) o Measurement range extension for current and voltage measurement o DC measuring bridges; 4-wire technology • Measurement of dynamic values o Rectified value, RMS value and form factor o Crest and peak values • Error calculation o Error limits of measuring instruments; error classes o Systematic and random measurement deviations o Error propagation • Linear characteristic adjustment o Correlation coefficient, coefficient of determination and covariance o Linear regression • Electrical measuring devices o Analogue measuring devices; devices for voltage, current, power, energy, frequency, time; TRMS devices o Power measurement in the single- and three-phase network o Oscilloscope: analogue and digital functionality • Digital frequency measurement and frequency spectra o Determination of frequency spectra; harmonics o Error analysis and measures to improve measurement accuracy • Bridge circuits for AC and DC (measurement of R, L, C parameters) o Wheatstone and Thomson Bridge (DC range) o AC bridges (Wien-Robinson; Maxwell-Wien) o Balancing conditions for AC bridges • Operational amplifiers and their use in measurement technology o Basic circuits and their basic equivalent circuits o Applications: amplifiers, Schmitt triggers, inverters, integrators, differentiators, adders, subtractors, comparators • Analogue-to-digital converter
	o Direct conversion: Parallel converter, cascade converter, scaling o Indirect conversion: Single-slope, dual-slope, charge-balancing converter, delta-sigma converter • Rotary encoders for servo systems o Analogue encoders (resolvers) and digital encoders (absolute, incremental) o Referencing of moving axes
4	Forms of teaching: Classroom teaching in the form of lectures, seminar lessons and practicals
5	Participation requirements: Formal: None Content: Knowledge from the following modules: 3421 Electrical Engineering I; 3422 Electrical Engineering II;
6	Forms of assessment: Written examination or project work or oral examination; in each case with preliminary examination performance
7	Prerequisite for the award of credit points: Module examination pass and course assessment
	Application of the module (in the following study programmes):

8	B.Eng. Mechatronics and Automation and B.Eng. Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr.-Ing. Christian Stöcker
11	Other information:
12	Language: English

Engineering Mechanics – Kinematics and Kinetic					EMKK
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:
3413	150	5	4th semester	Annual (summer)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the module, students are able to:

- Analyse movement processes of bodies, vehicle and machine components.
- Analyse the speeds and accelerations that occur during motion.
- Calculate trajectories of mass points and individual body points of a machine.
- Determine the forces and torques that occur during movement.
- Calculate the work done and the power or energy stored or released.
- Analyse shocks.
- Analyse simple vibration processes in technology.

3 Contents:

- Differentiation between kinematics and kinetics

Kinematics

- Movement of a mass point on a straight, circular and spatial path
- Uniform, uniformly accelerated and irregular movements
  *kinematic charts

Kinetics

- Kinetics of the mass point
- Newton's basic laws and principle of d'Alembert as well as their application
- Straight-line movement under the effect of a path-dependent force (harmonic vibration)
- Work, energy, power
- Impulse, impulse theorem, law of conservation of momentum for mass points
- Rotation of a body around a fixed axis
- Work, energy, power for rotary motion
- Impulse moment, impulse moment theorem, impulse moment conservation theorem for rotary motion
- General, plane movement of a rigid body

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

Participation requirements:

5	Formal:	None
	Content:	Knowledge from the following modules: 3385 Engineering Mechanics – Statics and Strengths of Materials
6	Forms of assessment: Written examination or oral examination	
7	Prerequisite for the award of credit points: Module examination pass and course assessment	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Andrea Kaimann	
11	Other information:	
12	Language: English	

Engineering Mechanics – Statics and Strengths of Materials					EMSM
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3385	150	5	3rd sem.	Annual (winter)	1 semester

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

2 Learning outcomes/competences:

On successful completion of the module, students are able to:

- Describe basic relationships of statics as the study of the equilibrium of forces in and on mechanical structures at rest.
- Determine the resulting effect of forces.
- Determine the effect of forces on substructures.
- Determine the internal forces and moments acting in substructures.
- Inspect the structural stability of systems.
- Calculate the forces acting at the points of contact or bearing.
- Determine the centres of gravity of bodies, surfaces or lines.
- Understand and analyse frictional operations.
- Determine tension distributions and maximum tensions in components.
- Determine the required dimensions and permissible loads of components using a strength test.
- Determine the deformation of components as a result of loads and compare it with maximum permissible values.

3 Contents:

- Basic concepts of mechanics: Force – Balance – Rigid Body
- Statics: Introduction – Plane system of forces – Centre of gravity – Static equilibrium of bodies – Free Body Diagram – Determination of support and intermediate reactions – Friction
- Strength of materials: Introduction to strength theory – Internal forces – Tensile or pressure load – Shear – Bending load – Torsional stress – Buckling stress – Composite stress

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass with preliminary examination

8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
	Module coordinator:
10	Prof. Dr.-Ing. Andrea Kaimann
11	Other information:
12	Language: English

Future Technologies & Sustainability									FTS
Identification number:	Workload:	Credits:	Study semester:			Course frequency:			Duration:
3375	150	5	1st semester			Annual (winter)			1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/classroom teaching		Self-study:	
	Lecture	60 students	1	weekly hours	15	h	22.5	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	2	weekly hours	30	h	45	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the module, students are able to:

- Describe the basic economic framework conditions of German companies at home and abroad,
- Distinguish the business divisions, functions and tasks relevant to industrial engineers,
- Identify current technical trends in future technologies and social trends such as sustainability and ethical aspects of digitalisation as well as classify the effects of these trends in the development of industrial engineers' job profile,
- Apply the VUCA model (volatility, uncertainty, complexity, ambiguity) to today's markets and companies and discuss it,
- Identify the Sustainable Development Goals and explain the impact of companies and employees on achieving these goals,
- Summarise the necessary professional and social skills of industrial engineers.

3 Contents:

- Basic knowledge of industrial enterprises (objectives, structure, types of enterprises, business functions) and analysis of industries and markets,
- Tasks of industrial engineers within different functional areas,
- Future trends in technology and society,
- VUCA model,
- 17 Sustainable Development Goals,
- Ethical aspects of digitalisation in companies
- Project-based work and communication in companies,
- Management soft skills,
- Scientific work (presentation, scientific writing),
- Excursions to companies with a focus on company processes and activities that are relevant for engineers

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

Formal:	None

	Content:	None
6	Forms of assessment: Term paper or written examination or oral examination	
	Prerequisite for the award of credit points:	
7	Module examination pass	
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr. rer. pol. Mariam Dopslaf	
11	Other information:	
12	Language: English	

Industrial Automation Technology					IAT
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3393	150	5	5th semester	Annual (winter)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

Upon successful completion of the course, students are able to identify the essential components of an automation system and explain their basic functioning. They are able to describe the mode of operation of conventional and PC-based programmable logic controllers and their differences. Students are familiar with selected IEC 61131 programming languages and are able to use them to implement simple programmes. Students are familiar with simple methods for designing sequence controls and can apply them to new problems and implement the design in a suitable programming language. They know the basics of bus systems and can name different bus systems and their areas of application.

3 Contents:

Introduction to control technology

- Terms and definitions
- Overview of the mode of operation of a controller (including sensors and actuators)

Bus technology

- Basics of industrial communication (incl. Ethernet-based bus systems, e.g. EtherCAT)
- Comparison of different bus systems and their areas of application

Design and structures of industrial controls

- PLC and PC-based control
- Information processing

Structured programming according to IEC 61131

- Graphics- and text-based programming languages
- Basics of object-oriented PLC programming

Sequence controls

- Model-based control design using UML state diagram
- Practical implementation (in an IEC 61131 programming language)

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

Formal:	None

	Content:	Knowledge from the following module:
		3423 Basics of Computer Science;
	Forms of assessment:	
6	Project work or oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes):	
	Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	according to RPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Christian Stöcker	
11	Other information:	
12	Language:	
	English	

Industrial Communication									ICM
Identification number:	Workload:	Credits:	Study semester:			Course frequency:			Duration:
3402	150	5	7th semester			Annual (winter)			1 semester

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

2 Learning outcomes/competences:

Students

- Know the ISO-OSI layer model and can use it to classify different industrial fieldbuses.
- Know the importance of the individual layers and their role in industrial communication.
- Learn the importance of real-time systems and their technical background.
- Are able to match technological and technical boundary conditions of fieldbuses with technical requirements in production and their products.
- Know the advantages and disadvantages of network topologies and can assign these user requirements.
- Are able to evaluate industrial communication systems in terms of their resource and cost efficiency.

Contents:

3	The ISO/OSI layer model • Physical layer: Media access (copper, fibre, radio), signal sampling and synchronisation, line codes • Data link layer: MAC & LLC, access methods, multiplexing, protocols and their backup, collision management, error detection and correction • Network layer: Routing, addressing • Transport layer: Connectionless and connection-oriented communication (e.g. TCP, UDP), quality of service (QoS); communication endpoints (sockets), connection establishment and termination • Session layer: Transaction security from unreliable channels, synchronisation • Presentation layer: Character representation, encoding, compression • Application layer: Application protocols and services, client-server models Industrially used examples of layers 1 and 2: • Synchronous and asynchronous BUS technologies • Real-time communication capability • Requirement of real-time systems • Measures for the realisation of real-time • Structure and usability of the Ethernet protocol • Industrial fieldbuses: with own protocol (e.g. AS-Interface, CAN, CANopen, Profibus, HART) • Ethernet-based fieldbuses (e.g. EtherCAT, ProfiNet) • Bus technologies with single-master; multi-master, masterless buses
4	Forms of teaching: Classroom teaching in the form of lectures, seminar lessons and practicals
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Term paper or written examination or project work or oral examination or a combination of term paper and written examination or a combination of project work and oral examination
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr.-Ing. habil. Thorsten Jungeblut
11	Other information:
12	Language: English

Innovation & Project Management					IPMN
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3382	150	5	2nd sem.	Annual (summer)	1 semester

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

2 Learning outcomes/competences:

Students

- Are prepared to lead product development and innovation projects and teams to success in terms of holistic and strategically oriented project management (also including agile methods).
- Understand the basics of project management and can use the elementary technical vocabulary.
- Can explain the most important instruments of project management.
- Are able to lead/manage a project in a given process-organisational project organisation.
- Are able to develop and specifically use control options for different project phases (controlling of the degree of completion, cost controlling).
- Can explain the specifics of team building and project management.
- Can carry out the moderation of team meetings projects.
- Know instruments of IT-supported project management.
- Can explain the importance of corporate goals and are able to distinguish between different leadership cultures.
- Can name essential aspects of industrial property protection.

Contents:

3	• Basics of project management (terms/methods/instruments) • Project phase models and planning systems (project preparation, project planning, project implementation, project completion) • Agile project management • Project organisation forms • Innovation and change management, self-management • Project planning (project structure plan/cost plan/resource plan/schedule) • Project documentation/project controlling • Risk management • Special features of the use of methods in innovation projects (strategic preparation/initiation, planning, monitoring and control of innovation projects) • Leading project and innovation teams (social structures, special communication situations in projects, real and virtual project work, problem analysis and concepts for action)	
	• Stakeholder management (factors influencing the successful management of projects) • Methods of idea generation (creativity techniques etc.) • Trainings and workshops on selected technical examples • Basic aspects of industrial property protection	
4	Forms of teaching:	
	Classroom teaching in the form of lectures and seminar lessons	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	Term paper or written examination or project work or oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes):	
	Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	according to RPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Michael Fahrig	
11	Other information:	
12	Language:	
	English	

Intercultural Communication									ICM
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:				
3376	150	5	1st semester	Annual (winter)	1 semester				

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

2	Learning outcomes/competences: The students are able to classify the most important terms, theories and models of intercultural management, have developed a deeper understanding of their own and foreign cultural imprints and understand how culture influences the perception individually and collectively and thus also shapes the perception processes in the world of work. Students can take intercultural aspects into account in communicative processes in working life.
3	Contents: • Multiculturalism: phenomenon of a globalised economy • Gender and diversity aspects • Cultural dimensions • Corporate culture • Typical application situations and concrete national cultures
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons
5	Participation requirements: Formal: German university entrance qualification Content: None
6	Forms of assessment: Term paper or written examination or project work or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr. rer. pol. Mariam Dopslaf
11	Other information:
12	Language: English

Introduction to German Culture & Language					IGCL
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3407	150	5	1st semester	Annual (winter)	1 semester

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

2 Learning outcomes/competences:

Upon completion of the module, students have

- Skills and competences at level A1 of the Common European Framework of Reference for Languages, i.e. they have a very basic range of simple phrases relating to personal matters and concrete needs.

They are able to:

- Understand and use familiar, everyday expressions and very simple sentences aimed at satisfying specific needs.
- Communicate in a simple way if the interlocutors speak slowly and clearly and are willing to help.
- Write short, simple texts.

3 Contents:

- The topics covered in the language classes are oriented towards situations or communicative actions that international students need directly to cope with their everyday life in Germany (e.g. filling out a form, making an appointment, describing daily routines, shopping groceries, booking a room, describing the way, ordering and complaining in the restaurant, etc.).
- Structures: The most important basic structures of the German language are developed: e.g. nominal phrases in sentences (declination, syntactic function), conjugation of regular, irregular and mixed verbs.
- Intercultural skills & socio-cultural knowledge: Forms of salutation and courtesy (forms of greeting, Siezen and Duzen), knowledge of Germany.

4 Forms of teaching:

Classroom teaching in the form of seminar lessons

5 Participation requirements:

Formal:	University entrance qualification obtained abroad
Content:	None

6 Forms of assessment:

Written examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

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

8	Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
	Importance of the grade for the final grade:
9	according to RPO
10	Module coordinator: HSBI's Language Center
11	Other information:
12	Language: German

Mathematics I									MATHS1	
Identification number:	Workload:		Credits:		Study semester:		Course frequency:		Duration:	
3378	150		5		1st semester		Annual (winter)		1 semester	
1	Course:	Planned group sizes:	Scope:		Actual contact time / classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Seminar teaching	30 students	2	weekly hours	30	h	45	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h
2	Learning outcomes/competences: On successful completion of the course, students • Are familiar with the mathematical way of working. • Are able to understand and apply the introduced mathematical notation. • Understand the basic terms and methods from the areas of algebra and analysis specified below. • Students can apply the learned methods to practice-oriented questions in the fields of technology, natural science, computer science and business.							
3	Contents: • General basics (set theory, inequalities, propositional logic, methods of proof) • Complex numbers (definition and representation, complex calculus) • Functions of one variable (limit and continuity, polynomial functions, broken rational functions, trigonometric functions, exponential function, logarithm function) • Differential calculus for functions of one variable (differentiability, derivation rules, applications) • Integral calculus for functions of one variable (fundamental theorem of differential and integral calculus, integration rules, integration methods, improper integrals, applications)							
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons							
5	Participation requirements:							
	Formal:	None						
	Content:	None						
6	Forms of assessment: Written examination or oral examination or a combination of written examination and oral examination							
7	Prerequisite for the award of credit points: Module examination pass							
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)							
	Importance of the grade for the final grade:							

9	according to RPO
	Module coordinator:
10	Dr. rer. nat. Lisa Teich
11	Other information:
12	Language:
	English

Mathematics II					MATHS2
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3383	150	5	2nd sem.	Annual (summer)	1 semester

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

2 Learning outcomes/competences:

On successful completion of the course, students

- Understand the basic terms and methods from the areas of linear algebra specified below.
- Have enhanced their knowledge in the field of analysis and master the essential principles of differential calculation for functions of several variables.
- Know the most important numerical algorithms and their possible applications and are able to handle numerical problems and estimate errors of numerical calculations.
- Can implement simple algorithms in a higher programming language on a computer.
- Can develop functions into their Taylor series.
- Can apply the learned methods to practice-oriented questions in the fields of technology, natural science, computer science and business.

3 Contents:

- Linear algebra (vectors, matrices, determinants, systems of linear equations, eigenvalues and eigenvectors)
- Differential calculus for functions of several variables (functions of several variables, partial differentiation)
- Numerics (numerical determination of zeros, numerical differentiation, numerical integration)
- Taylor series
- Fourier series
- Use of software such as MATLAB C++, Python

4 Forms of teaching:

Courses in the form of lectures and seminar lessons

5 Participation requirements:

Formal:	None
Content:	Knowledge from the following module: 3378 Mathematics I;

Forms of assessment:

6	Written examination or oral examination or a combination of written examination and oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Dr. rer. nat. Lisa Teich
11	Other information:
12	Language: English

Mathematics III									MATHS3
Identification number	Workload	Credits	Study semester	Frequency of the offer:	Duration
3411	150	5	3rd sem.	Annual (winter)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	2	weekly hours	30	h	45	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the course,

- Students have an overview of the methods for the analytical solution of ordinary differential equations and systems of differential equations and can apply these to practice-oriented problems.
- Know the most important numerical methods for solving differential equations and their possible applications and are able to handle numerical problems and estimate errors of numerical calculations.
- Can implement simple algorithms in a higher programming language on a computer.
- Can develop functions into their Fourier series.
- Students are familiar with the fundamentals and properties of Fourier and Laplace transforms and can apply them to practice-oriented questions.

3 Contents:

- Ordinary differential equations (differential equations of the 1st order, linear differential equations of the 2nd or nth order with constant coefficients, systems of linear differential equations)
- Numerical solution of differential equations
- Fourier transform
- Laplace transform
- Use of software such as MATLAB C++, Python

4 Forms of teaching:

Classroom teaching in the form of lectures and seminar lessons

5 Participation requirements:

Formal:	–
Content:	Knowledge from the following modules: 3378 Mathematics I; 3383 Mathematics II;

Forms of assessment:

6	Written examination or oral examination or a combination of written examination and oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Dr. rer. nat. Lisa Teich
11	Other information: –
12	Language: English

Measuring Systems and Sensor Technology					MUSE
Identification number	Workload	Credits	Study semester	Frequency of the offer:	Duration
3416	150	5	5th semester	Annual (winter)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

After successfully completing this module, students know the most important principles for converting physical variables (e.g. temperature, pressure, flow rate, power) into electrical signals and are able to explain them. They are familiar with common types of sensors and can justify their use in practice-oriented applications. Students can analyse analogue sensor electronics, especially for signal pre-processing. The students learn about known sensor systems in the industrial environment and can schedule and justify their application.

3 Contents:

- Basics of measurement signal processing
- Sensors and measuring systems in industrial application
- Components of measuring signal acquisition and processing systems
- Temperature measurement
- Pressure measurement
- Flow measurement
- Level measurement
- Measurement of substance properties
- Measurement of geometric quantities (especially position detection)
- Optical inspection systems
- Power and energy measurement

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

Formal:	None
Content:	Knowledge from the following modules: 3412 Electrical Measurement Technology;

6 Forms of assessment:

Combination of project work and oral examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass and course assessment

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

Mechatronics and Automation, Mechatronics and Automation (work-integrated)

9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr.-Ing. Christian Stöcker
11	Other information:
12	Language: English

Mechatronic Systems I									MSE1
Identification number:	Workload:	Credits:	Study semester:			Frequency of the offer:			Duration:
3417	150	5	6th semester			Annual (summer)			1 semester
1	Course:	Planned group sizes:	Scope:			Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours		30	h	45	h
	Sem. lessons	30 students	2	weekly hours		30	h	45	h
	Exercise	20 students	0	weekly hours		0	h	0	h
	Practical or seminar	15 students	0	weekly hours		0	h	0	h
	Supervised self-study	60 students	0	weekly hours		0	h	0	h
2	Learning outcomes/competences:								

On successful completion of the module, students are able to ...

- Understand and apply the basics and significance of documentation in mechatronics.
- Create technical documentation for mechanical and electronic components as well as software using suitable tools (AutomationML, Polarion, Enterprise Architect etc.).
- Analyse and apply agile ways of working and methods used by successful companies.
- Use the development methodology of mechatronic systems, including documentation and traceability.
- Understand and assess the principles and fields of application of artificial intelligence (AI) in the context of mechatronics and apply them appropriately in product development.
- Divide complex mechatronic systems into meaningful modules and develop them in parallel.
- Structure work packages and work on them as a team.
- Apply the learned methodologies successfully to different products, taking into account sustainability and diversity aspects.
- Think in an interdisciplinary manner, combining mechanics, electrical engineering and software engineering.
- Understand and apply the basics and benefits of customer benefit analysis to develop a product that delivers the highest value to the customer.
- Interpret and carry out safety and business assessments (e.g. calculation, marketing) of these systems.
- Are able to work in a problem-oriented, interdisciplinary manner, using strategies of project management and their social skills, both independently and in a team.
- Formulate, present and discuss technical solutions and points of view.

	Contents:

3	• Basics of mechatronic systems and the importance of documentation in mechatronics • Technical documentation for mechanical, electronic and information technology components • Use and integration of artificial intelligence (AI) in the development process of mechatronic systems • Foundation and management of a virtual start-up company. • Conducting customer analyses, including diversity and sustainability aspects. • Technical translation and requirements management: Transform customer and project requirements into usable features.	
	• Ideas management: Generation, evaluation and selection of ideas using creativity techniques. • Application of agile methods to design competitive products early and minimise time, quality, and cost intensity in the product development process. • Conducting of usability studies, including diversity aspects. • Development and implementation of technical and economic feasibility studies using tools such as 3D printing, cardboard engineering, digital mock-up etc. • Project declaration: Summary and presentation of project data and objectives. • Creation of a product requirements document as a basis for further project steps.	
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Term paper or project work or oral examination	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Maik Lauterbach	
11	Other information:	
12	Language: English	

Mechatronic Systems II									MSE2	
Identification number:		Workload:		Credits:		Study semester:		Frequency of the offer:		Duration:
3419		150		5		7th semester		Annual (winter)		1 semester
1	Course:		Planned group sizes:		Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture		60 students		2	weekly hours	30	h	45	h
	Sem. lessons		30 students		2	weekly hours	30	h	45	h
	Exercise		20 students		0	weekly hours	0	h	0	h
	Practical or seminar		15 students		0	weekly hours	0	h	0	h
	Supervised self-study		60 students		0	weekly hours	0	h	0	h
2	Learning outcomes/competences:									
	On successful completion of the module, students are able to ... • Develop and evaluate complex mechatronic/cyber-physical and automated systems on an analytical level. • Apply a systematic development process to design products that meet customer and requirements specifications. • Integrate mechanical, electronic and software principles to create mechatronic/cyber-physical systems. • Integrate new systems or components in a mechatronic/cyber-physical system. • Distinguish different control types and evaluate their suitability for different applications in mechatronics. • Design and implement modern control architectures to optimise the functionality and efficiency of mechatronic systems. • Bring competitive concepts close to production. • Determine the function, features and quality requirements for a specific system and implement them sustainably. • Work on their product idea in the Makerspace. • Assess complex issues and generate different requirements and system solutions across industries. • Interpret these systems' business evaluations. • Relate principles of self-management and learning and problem-solving techniques to strategies of project management and teamwork. • Work problem-oriented and interdisciplinary, both independently and as a team. • Integrate AI systems effectively into the development of mechatronic and automated systems.									
	Contents:									

3	• Systematic development of mechatronic/cyber-physical and automated systems: This covers all aspects of the development, from planning and conception to implementation and initial operation. • Use of Artificial Intelligence (AI) in mechatronic/cyber-physical systems: overview of the possible applications and effects of AI on the development process and control technology. • Control types and architectures in mechatronic systems: understanding the different control types and gain deeper insight into control architectures to optimise their selection and implementation in the development of mechatronic systems. • Creativity methods: introduction to creativity methods to foster creativity in the development and
	design of mechatronic systems. • Sustainable and economic assessment of concepts: methods for assessing the technical and economic aspects of designs, with a focus on sustainability. • Requirement management: creation of functional specifications for deriving auditable requirements, as well as creation of development test plans. • Modelling and simulation: concretisation of concepts through modelling and simulation to improve system efficiency and performance. • Implementation and prototyping: use of various design methods to produce prototypes and prepare for series production. • Integrating diversity into system development: consideration of diversity aspects in the development of mechatronic/cyber-physical and automation systems. • Documentation and presentation: learning techniques to effectively document and present project results.
4	Forms of teaching: Mechatronics and Automation, Mechatronics and Automation (work-integrated)
5	Participation requirements: Formal: – Content: –
6	Forms of assessment: Term paper or oral examination or a combination of term paper and oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr.-Ing. Maik Lauterbach
11	Other information: -
12	Language: English

Microcontroller Programming					MPM
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
3399	150	5	6th semester	Annual (summer)	1 semester

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

2 Learning outcomes/competences:

Students

- Learn the basics of embedded systems based on microcontrollers and single-board computers.
- Gain practical experience in designing embedded microcontroller-based systems, sensor networks and machine-to-machine (M2M) communications.
- Are able to design and implement their own microcontroller-based hardware projects.
- Can evaluate and make judgements about systems or products based on embedded systems, e.g. performance or resource efficiency.
- Can translate customer requirements into viable technical concepts and product architectures, taking into account efficiency and modularity.

3 Contents:

- Fundamentals of Embedded Systems and Internet of Things (IoT)
- Fundamentals of processor architectures
- Embedded systems platforms (e.g. Arduino, Raspberry PI, ARM)
- Concepts and tools for the development of embedded systems
- Reading out sensors, controlling actuators
- Special peripheral components of microcontrollers (e.g. serial/parallel I/O channels, interrupt controllers, DMA controllers, AD/DA converters, counters and timers, Watchdog, power saving modes)
- Communication via bus systems, M2M communication (e.g. I2C, SPI, UART)
- Integration into overall systems

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

	Formal:	None
	Content:	None
6	Forms of assessment: Term paper or written examination or project work or oral examination or a combination of term paper and written examination or a combination of	
	project work and oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Christian Stöcker	
11	Other information:	
12	Language: English	

Object Oriented Programming					OOP
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer:	Duration:
3409	150	5	2nd sem.	Annual (summer)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

After successful completion of the module, the students have an understanding of object-oriented programming and can explain the distinctions and differences from structured programming. They can analyse concrete problems from IT and design and implement suitable solutions in the programming language C++. The students have gained knowledge of selected models of UML (in particular class diagrams) and can apply them to new problems.

3 Contents:

Introduction to object-oriented programming:

- Basic concepts (abstraction, data encapsulation, inheritance, polymorphism)
- Differences between procedural and object-oriented programming

Programming in C++:

- Classes (including attributes and methods), access modifiers
- Objects and class elements
- Operators and operator overloading
- Inheritance and polymorphism
- Class templates
- Error handling

Software development:

- UML (e.g. class diagram and sequence diagram)
- Development models (V-model)
- Selected design patterns
- Unit tests

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

Formal:

	Content:	Structured programming (ideally with C), general informatics basics Knowledge from the following modules: 3423 Basics of Computer Science
6	Forms of assessment: Written exam or project work	
7	Prerequisite for the award of credit points: Module examination pass and course assessment	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Christian Stöcker	
11	Other information:	
12	Language: English	

Physics					PHS
Identification number:	Workload:	Credits:	Study semester:	Course frequency: :	Duration:
3381	150	5	2nd sem.	Annual (summer)	1 semester

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

2 Learning outcomes/competences:

Upon successful completion of the module, students are able to ...

- Identify physically motivated problems within their field of expertise.
- Select meaningful solution strategies for physical tasks.
- Select appropriate formulas to solve and apply to specific problems.
- Use important physical units and numerical representations for calculations and the acquisition and further processing of measured values.
- Perform physical tests and interpret and document their work results.

3 Contents:

Introduction to physics and basics:

- Subdomains of physics
- Conventions and mathematical basics
- Units and estimating orders of magnitude
- Basics of measurement and error handling
- Kinematics: kinematics of mass points, one- and multi-dimensional linear motion with constant acceleration, rotational motion
- Dynamics: Newtonian axioms, energy and work for linear and rotational motion

Optics:

- Geometrical optics: light beams, reflection, refraction, dispersion, imaging through lenses and lens systems
- Wave optics: electromagnetic waves, polarised light, interference, coherence, diffraction

4 Forms of teaching:

Classroom teaching in the form of lectures, seminar lessons and practicals

5 Participation requirements:

Formal:	None
Content:	None

6	Forms of assessment: Written examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Dr. rer. nat. Lisa Teich
11	Other information:
12	Language: English

Power Electronics									PET
Identification number:		Workload:		Credits:		Study semester:		Frequency of the offer:	Duration:
3418		150		5		6th semester		Annual (summer)	1 semester
1	Course:		Planned group sizes:		Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture		60 students		2	weekly hours	30	h	45	h
	Sem. lessons		30 students		1	weekly hours	15	h	22.5	h
	Exercise		20 students		0	weekly hours	0	h	0	h
	Practical or seminar		15 students		1	weekly hours	15	h	22.5	h
	Supervised self-study		60 students		0	weekly hours	0	h	0	h
2	Learning outcomes/competences:									
	After successfully completing the course, the students have understood the structure and the operating principle of converter circuits (rectifier, boost converter, low converter, 4-quadrant converter) and can describe them in their own words. The students have set up or programmed control circuits for controlling the power semiconductors (pulse width modulation) and have understood the principles behind the control methods so that they can reproduce them in their own words. In addition, students can estimate the losses occurring in power electronic circuits and calculate suitable heat sinks. In addition, students can use Fourier transformation to analyse the signals occurring in power electronic circuits. In small groups, the students have set up converter circuits, controlled them, examined them in terms of measurement technology and demonstrated the theoretical foundations.									
	Contents:									

3	General Aspects • Switching of ohmic-inductive loads • Introduction to power semiconductors • Thermal conductivity model • Switching behaviour of power semiconductors Power converter circuits • Single-pulse rectifier • Multi-pulse rectifier • Boost/buck converter • H-Bridge inverter • Three-phase inverters • Inverter circuit • Harmonics and power Application circuits in automation • Switching power supplies • Electronic switches • Electronic actuators	
4	Forms of teaching:	
	Classroom teaching in the form of lectures, seminar lessons and practicals	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	Written examination or project work or oral examination	
7	Prerequisite for the award of credit points:	
	Module examination pass and course assessment	
8	Application of the module (in the following study programmes):	
	Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade:	
	according to RPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Michael Leuer	
11	Other information:	
12	Language:	
	English	

Practical Project/Internship					PPI
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
1406	180	6	6th semester	each semester	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/classroom teaching		Self-study:	
	Lecture	60 students	0	weekly hours	0	h	180	h
	Seminar teaching	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the module, students are able to:

- Apply and enhance study programme-specific knowledge and skills in practice.
- Work on individual issues in the company providing training holistically and under practical conditions and independently develop solution options.
- Apply their scientific work skills and gradually expand them.
- Document the individual problems and solution options dealt with in the company providing training in a scientific paper.

3 Contents:

- The topics to be dealt with represent current issues of the company provided training.
- If relevant to the issue, technical trends such as future technologies and social trends such as sustainability are also addressed.
- The topics to be worked on must be related to engineering science and be oriented towards the module contents of the curriculum.
- The topic is agreed between the student, the supervisor in the company and the examiner at the university.

4 Forms of teaching:

None

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Proof of practical experience form

7 Prerequisite for the award of credit points:

Proof of practical experience form

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

Industrial Engineering B.Eng., Mechatronics and Automation B.Eng.

9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr. rer. pol. Mariam Dopslaf
11	Other information: The practical project/internship is ungraded.
12	Language: English

Project 1					PRIN1
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
1407	180	6	4th semester	Annual (summer)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/classroom teaching		Self-study:	
	Lecture	60 students	0	weekly hours	0	h	180	h
	Seminar teaching	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: On successful completion of the module, students are able to: • Work independently on individual problems from engineering. • Apply their scientific work skills and gradually expand them. • Document the individual problems and solution options dealt with in a scientific paper.
3	Contents: • The topics to be dealt with represent current issues from the field of engineering. • If relevant to the issue, technical trends such as future technologies and social trends such as sustainability are also addressed. • The topics to be worked on must be related to engineering science and be oriented towards the module contents of the curriculum. • The topic is coordinated between the student and the examiner at the university.
4	Forms of teaching:
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Term paper
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Industrial Engineering, Mechatronics and Automation
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr. rer. pol. Mariam Dopslaf
	Other information:

11	After consultation with the supervising lecturer, Project 1 can also be processed as part of a company internship.
12	Language: English

Project 2					PRIN2
Identification number:	Workload:	Credits:	Study semester:	Course frequency:	Duration:
1408	180	6	5th semester	Annual (winter)	1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	0	weekly hours	0	h	180	h
	Seminar teaching	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

On successful completion of the module, students are able to:

- Work independently on individual problems from engineering.
- Apply their scientific work skills and gradually expand them.
- Document the individual problems and solution options dealt with in a scientific paper.

3 Contents:

- The topics to be dealt with represent current issues from the field of engineering.
- If relevant to the issue, technical trends such as future technologies and social trends such as sustainability are also addressed.
- The topics to be worked on must be related to engineering science and be oriented towards the module contents of the curriculum.
- The topic is coordinated between the student and the examiner at the university.

4 Forms of teaching:

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Term paper

7 Prerequisite for the award of credit points:

Module examination pass

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

Industrial Engineering, Mechatronics and Automation

9 Importance of the grade for the final grade:

according to RPO

10 Module coordinator:

Prof. Dr. rer. pol. Mariam Dopslaf

11 Other information:

After consultation with the supervising lecturer, Project 2 can also be processed as part of a company internship.

12 Language:

Semiconductor Devices and Circuits									SDC
Identification number	Workload:	Credits:	Study semester:			Frequency of the offer:			Duration
3414	150	5	4th semester			Annual (summer)			1 semester

1	Course:	Planned group sizes:	Scope:		Actual contact time/ classroom teaching		Self-study:	
	Lecture	60 students	2	weekly hours	30	h	45	h
	Sem. lessons	30 students	1	weekly hours	15	h	22.5	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	1	weekly hours	15	h	22.5	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences:
	After successful completion of the course, students will be able to describe the operating behaviour of active and passive components of electronics in their own words. The students have understood the function of the components and can select suitable components for a corresponding application and determine the operating point by means of characteristic curve fields and the descriptive equations. In small groups, the students gained their first experience with measuring components and evaluating the results. The students are able to interpret electronic circuits, understand the functional principle and determine the current and voltage curves in the circuits. In small groups, the students gained their first experience of calculation, design, construction and testing of basic electrical circuits.
	Contents:

3	Semiconductor diodes • Construction and designs • Characteristic curves and values • Circuit examples Bipolar transistors • Types: o Bipolar transistors (NPN and PNP) o Unipolar (MOS) transistors o Insulated Gate Bipolar Transistor (IGBT) • Construction and designs • Characteristic curves and values • Circuit examples Unipolar thyristors • Construction and designs • Characteristic curves and values • Circuit examples Operational amplifier (OPA) • Functional principle • Analogue OPA circuits Optoelectronic components Semiconductor circuits • Digital circuits • Transistor as switch • Toggle circuits • Basic logic circuits	
4	Forms of teaching: Classroom teaching in the form of lectures, seminar lessons and	
	practicals.	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Written examination or project work or oral examination	
7	Prerequisite for the award of credit points: Module examination pass and course assessment	
8	Application of the module (in the following study programmes): Mechatronics and Automation, Mechatronics and Automation (work-integrated)	
9	Importance of the grade for the final grade: according to RPO	
10	Module coordinator: Prof. Dr.-Ing. Michael Leuer	
11	Other information:	
12	Language: English	

Statistics						STAS	
Identification number:	Workload:	Credits:	Study semester:		Course frequency:	Duration:	
3387	150	5	3rd or 4th semester		Each semester	1 semester	

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

2	Learning outcomes/competences: On successful completion of the course, students • Can explain the basic concepts of statistics. • Can apply the basic methods and procedures of descriptive statistics and probability theory. • are able to analyse economic questions and problems with statistical methods and to show correlations. • Are able to solve tasks with the help of suitable software (SPSS, Excel, MATLAB).
3	Contents: • Basic concepts of statistics • Descriptive statistics (one-dimensional frequency distributions, measures for one-dimensional distributions, bivariable distributions, regression analysis) • Basics of probability theory • Probability distributions • Assessing statistics (hypothesis tests, point and interval estimators) • Use of software, e.g. Excel, SPSS, MATLAB
4	Forms of teaching: Classroom teaching in the form of lectures and seminar lessons
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination or project work or oral examination or a combination of written examination, project work and oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes): Industrial Engineering, Industrial Engineering (work-integrated), Mechatronics and Automation, Mechatronics and Automation (work-integrated)
9	Importance of the grade for the final grade: according to RPO
10	Module coordinator: Prof. Dr. Adam-Alexander Manowicz
	Other information:

11	
	Language:
12	English