TECHNISCHE UNIVERSITÄT DRESDEN

Fakultät Elektrotechnik und Informationstechnik

Directory of Modules for Visiting Students *Diplom* Programme in Mechatronics

Faculty of Electrical and Computer Engineering

Information Package for International Visiting and Exchange Students

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FAKULTÄT ELEKTROTECHNIK UND INFORMATIONSTECHNIK

The Faculty of Electrical and Computer Engineering (*Fakultät Elektrotechnik und Informationstechnik*), the Faculty of Mechanical Science and Engineering and the "Friedrich List" Faculty of Transportation and Traffic Sciences at the Technische Universität Dresden offer the *Diplom* degree programme in Mechatronics. This programme is an integrated five-year (single-tier) programme and thus includes Bachelor as well as Master's level.

Structure of the *Diplom* degree programme in Mechatronics

The degree programme in Mechatronics is divided into basic studies and main studies. The basic studies include semester 1 until semester 4 (= the first two years of the programme); the main studies start in the 5th semester and are concluded in the 10th semester (= 3rd until 5th year of the programme).
The following catalogue is organized according to these two stages. In the first part, you will find the modules listed that are part of our basic studies (please see here for the list). From page 3 on, you will find information on the modules that are part of our main studies (please see here for a list).

SWS – Semesterwochenstunden

In the module descriptions (line „modes of teaching and learning") you will find the abbreviation *SWS*. This abbreviation stands for the German term *Semesterwochenstunde* and gives the amount of lessons per week.

1 SWS = 1 lesson of 45 minutes per week during the semester

At the TU Dresden, lessons usually last for 90 minutes (= 1 Doppelstunde (DS)).

1 DS = 2 SWS

What does this mean for your timetable?
For example, for the module MT-12 02 22 Power Electronics, the amount of SWS is given as follows: 2/1/0. This means that the module includes the following modes of teaching: 2 SWS lecture (1st number), 1 SWS tutorial (2nd number), 0 SWS lab course (3rd number); which means:

- 90 minutes lecture every week during the semester
- 90 minutes tutorial every 2nd week during the semester
  (Also possible, but less common: 45 minutes tutorial every week during the semester)
- No lab course

Academic calendar of the TU Dresden

The academic year at the TU Dresden is divided into the winter semester (October–March) and summer semester (April–September). The semester dates for the following academic years can be found here.
Our module descriptions inform you in which semester, i.e. winter or summer semester, the respective module is offered. When setting up your learning agreement, it is important to consider at first which semester you are coming to the TU Dresden (either the winter or summer semester) and then choose appropriate modules.

Note: The English version of our module descriptions is not legally binding.

Basic studies modules (Bachelor level)

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
MT-12 08 01	Fundamentals of Electrical Engineering (*Grundlagen der Elektrotechnik*)	2/2/0 PL		1st year	German	**6**
MT-12 08 23	Electric and Magnetic Fields (*Elektrische und magnetische Felder*)		2/2/0 PL	1st year	German	**4**
MT-12 05 01	Electronic Systems Design (*Geräteentwicklung*)		2/2/0 PL	1st year	German	**4**
MT-13 00 01	Materials and Engineering Mechanics (*Werkstoffe und Technische Mechanik*)	2/1/0 PL	2/2/0 PL	1st year	German	**7** (3+4)
MT-12 08 03	Dynamic Networks (*Dynamische Netzwerke*)	2/2/1 PL	0/0/1 PL	2nd year	German	**7** (6+1)
MT-12 09 01	Systems Theory (*Systemtheorie*)	2/1/0	2/2/0 PL	2nd year	German	**7**
MT-12 01 02	Automation Engineering and Measurement (*Automatisierungs- und Messtechnik*)		3/2/0 PL	2nd year	German	**5**
MT-12 04 01	Electrical Power Engineering (*Elektroenergietechnik*)	3/1/0 PL	0/0/1 PL	2nd year	German	**5** (4+1)
MT-12 02 21	Circuit Design (*Schaltungstechnik*)		2/1/0 PL	2nd year	German	**4**
MT-13 01 02	Fundamentals of Kinematics and Kinetics (*Grundlagen der Kinematik und Kinetik*)	2/2/0 PL		2nd year	German	**5**
MT-13 12 01	Construction and Manufacturing Engineering (*Konstruktion und Fertigungstechnik*)	5/2/0 2 PL	0/1/0 PL	2nd year	German	**10** (8+2)
MT-13 01 04	Kinematics and Materials of Mechanics, Advanced (*Vertiefung Kinematik und Festigkeitslehre*)		3/3/0 PL	2nd year	German	**7**

The numbers in the columns "winter semester" and "summer semester" indicate in which semester the respective module is delivered. Further, these numbers refer to the SWS for the respective module. The 1st number refers to the SWS for the lecture, the 2nd to the SWS for the tutorial and the 3rd to the SWS for the lab course (Please see here for more details).

PL = *Prüfungsleistung*/assessment

Main studies modules (5th until 10th semester)

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS- credits
MT-13 01 01	Field Theory (*Feldtheorie*)		2/2/0 PL	3rd year	German	**5**
MT-13 01 02	Numerical Methods/System Dynamics (*Numerische Methoden/Systemdynamik*)	4/2/0 2 PL	0/0/1 PL	3rd year	German	**9** (8+1)
MT-12 02 22	Power Electronics (*Leistungselektronik*)	2/1/0 2 PL		3rd year	German	**4**
MT-12 13 01	Control of Continuous-Time Processes and Discrete Event Systems (*Regelungstechnik und Ereignisdiskrete Systeme*)	5/2/0 2 PL	0/0/1 PL	3rd year		**9** (8+1)
MT-12 01 23	Micro Computer Engineering/Embedded Controller (*Mikrorechentechnik/Embedded Controller*)	2/0/1	3/0/3 3 PL	3rd year		**10** (3+7)
MT-12 08 25	Measurement and Sensor Techniques/Actuators (*Mess- und Sensortechnik/Aktorik*)	2/1/0 PL	2/0/2 3 PL	3rd year	German	**9** (4+5)

The numbers in the columns "winter semester" and "summer semester" indicate in which semester the respective module is delivered. Further, these numbers refer to the SWS for the respective module. The 1st number refers to the SWS for the lecture, the 2nd to the SWS for the tutorial and the 3rd to the SWS for the lab course (Please see here for more details).

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Elective modules, group "methods"

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
MT-M01-G	Multi Body Systems, Basics (*Mehrkörpersysteme Grundlagen*)		3/2/0 PL	4th year	German	**7**
MT-M01-V	Multi Body Systems, Advanced (*Mehrkörpersysteme Vertiefung*)	3/3/0 3 PL		5th year	German	**7**
MT-M02-G	Fluid Power Systems, Basics (*Fluidtechnische Systeme Grundlagen*)		2/2/1 3 PL	4	German	**7**
MT-M02-V	Fluid Power Systems, Advanced (*Fluidtechnische Systeme Vertiefung*)	3/1/1 3 PL		5	German	**7**
MT-M03-G	Mechanical Construction, Basics (*Maschinenkonstruktion Grundlagen*)	2/0/1 2 PL 2nd part	2/0/1 2 PL 1st part	4th and 5th year	German	**7**
MT-M03-V	Mechanical Construction, Advanced (*Maschinenkonstruktion Vertiefung*)		3/2/0 2 PL	4th year	German	**7**
MT-M04-G	Control, Basics (*Regelung und Steuerung Grundlagen*)		4/2/0 2 PL	4th year	German	**7**
MT-M04-V	Control, Advanced (*Regelung und Steuerung Vertiefung*)	2/1/0 PL 2nd part	2/0/0 PL 1st part	4th and 5th year	German	**7**
MT-M05-G	Electric Drive Technology, Basics (*Elektrische Antriebstechnik Grundlagen*)		4/2/0 2 PL	4th year	German	**7**
MT-M05-V	Electric Drive Technology, Advanced (*Elektrische Antriebstechnik Vertiefung*)	2/1/2 2 PL		5th year	German	**7**
MT-M06-G	Process Control Engineering, Basics (*Prozessinformationsverarbeitung Grundlagen*)		4/0/2 2 PL	4th year	German	**7**
MT-M06-V	Process Control Engineering, Advanced (*Prozessinformationsverarbeitung Vertiefung*)	2/4/0 2 PL		5th year	German	**7**
MT-M07-G	Design Techniques, Basics Entwurfstechniken Grundlagen	2/1/0 PL	2/1/0 PL	4th and 5th year	German	**7**
MT-M07-V	Design Techniques, Advanced (*Entwurfstechniken Vertiefung*)	2/1/0 PL 2nd part	2/1/0 PL 1st part	4th and 5th year	German	**7**

The numbers in the columns "winter semester" and "summer semester" indicate in which semester the respective module is delivered. Further, these numbers refer to the SWS for the respective module. The 1st number refers to the SWS for the lecture, the 2nd to the SWS for the tutorial and the 3rd to the SWS for the lab course (Please see here for more details). | PL = *Prüfungsleistung*/assessment

Elective modules, group "applications"

Module number	Module name	Winter semester	Summer semester	Level	Language of instruction	ECTS-credits
MT-A01-G	Automotive Vehicle Engineering, Basics (*Kraftfahrzeugtechnik Grundlagen*)	2/1/0 PL 2nd part	2/0/0 PL 1st part	4th and 5th year	German	**7**
MT-A01-V	Automotive Vehicle Engineering, Advanced (*Kraftfahrzeugtechnik Vertiefung*)	2/0/0 PL 2nd part	4/1/0 2 PL 1st part	4th and 5th year	German	**7**
MT-A02-G	Railway Vehicle Engineering, Basics (*Schienenfahrzeugtechnik Grundlagen*)		4/0/0 PL	4th year	German	**7**
MT-A02-V	Railway Vehicle Engineering, Advanced (*Schienenfahrzeugtechnik Vertiefung*)	3/1/0 PL		5th year	German	**7**
MT-A03-G	Combustion Engines, Basics (*Verbrennungsmotoren Grundlagen*)		3/2/1 3 PL	4th year	German	**7**
MT-A03-V	Combustion Engines, Advanced (*Verbrennungsmotoren Vertiefung*)	4/0/1 2 PL		5th year	German	**7**
MT-A04-G	Motion Control, Basics (*Bewegungssteuerung Grundlagen*)		4/2/0 PL	4th year	German	**7**
MT-A04-V	Motion Control, Advanced (*Bewegungssteuerung Vertiefung*)	2/1/2 2 PL		5th year	German	**7**
MT-A05-G	Aerospace Engineering, Basics (*Luft- und Raumfahrttechnik Grundlagen*)		3/3/0 2 PL	4th year	German	**7**
MT-A05-V	Aerospace Engineering, Advanced (*Luft- und Raumfahrttechnik Vertiefung*)	4/1/0 2 PL		5th year	German	**7**
MT-A06-G	Mobile Work Machines, Basics (*Mobile Arbeitsmaschinen Grundlagen*)		4/2/0 2 PL	4th year	German	**7**
MT-A06-V	Mobile Work Machines, Advanced (*Mobile Arbeitsmaschinen Vertiefung*)	2/2/2 2 PL		5th year	German	**7**
MT-A07-G	Motion Controlled Machine Systems, Basics (*Bewegungsgeführte Maschinensysteme Grundlagen*)		3/2/0 PL	4th year	German	**7**
MT-A07-V	Motion Controlled Machine Systems, Advanced (*Bewegungsgeführte Maschinensysteme Vertiefung*)	2/1/2 2 PL		5th year	German	**7**
MT-A08-G	Robotics, Basics (*Robotik Grundlagen*)		5/1/0 2 PL	4th year	German	**7**
MT-A08-V	Robotics, Advanced	3/2/2		5th year	German	**7**

	(*Robotik Vertiefung*)	2 PL				
MT-A09-G	Specific Production Methods, Basics (*Spezielle Fertigungsmethoden Grundlagen*)		3/1/1 2 PL	4th year	German	**7**
MT-A09-V	Specific Production Methods, Advanced (*Spezielle Fertigungsmethoden Vertiefung*)	3/1/2 3 PL		5th year	German	**7**
MT-A10-G	Electronic Systems and Technolgy, Basics (*Gerätetechnik Grundlagen*)		2/4/0 PL	4th year	German	**7**
MT-A10-V	Electronic Systems and Technolgy, Advanced (*Gerätetechnik Vertiefung*)	4/2/0 2 PL		5th year	German	**7**
MT-A11-G	Micro-Electro-Mechanical-Systems, Basics (*Mikro-Elektro-Mechanische Systeme Grundlagen*)		4/3/0 PL	4th year	German	**7**
MT-A11-V	Micro-Electro-Mechanical-Systems, Advanced (*Mikro-Elektro-Mechanische Systeme Vertiefung*)	2/0/2 2 PL 2nd part	2/0/0 PL 1st part	4th and 5th year	German	**7**
MT-A12-G	Biomedical Engineering, Basics (*Biomedizintechnik Grundlagen*)		5/1/0 PL	4th year	German	**7**
MT-A12-V	Biomedical Engineering, Advanced (*Biomedizintechnik Vertiefung*)	3/2/1 2 PL		5th year	German	**7**
MT-A13-G	Sensors and Measuring Systems, Basics (*Sensoren und Messsysteme Grundlagen*)		4/2/0 3 PL	4th year	German	**7**
MT-A13-V	Sensors and Measuring Systems, Advanced (*Sensoren und Messsysteme Vertiefung*)	2/1/2 3 PL		5th year	German	**7**
MT-A14-G	Electrified Mobility (*Elektrifizierte Mobilität*)	3/0/2 2 PL		5th year	German	**7**

The numbers in the columns "winter semester" and "summer semester" indicate in which semester the respective module is delivered. Further, these numbers refer to the SWS for the respective module. The 1st number refers to the SWS for the lecture, the 2nd to the SWS for the tutorial and the 3rd to the SWS for the lab course (Please see here for more details).

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Module descriptions

Module descriptions – basic studies (1st–4th semester)

Module number	**Module name**	**Lecturer in charge**
ET-12 01 02 (MT-12 01 02 RES-G11)	Automation Engineering and Measurement (Automatisierungs- und Messtechnik)	Prof. Dr. techn. K. Janschek
Contents and objectives	Content: 1. Fundamentals of automation engineering wit the focus on behavioural description, control design in the frequency domain, digital control loops, industrial standard controllers, discrete-event control systems, elementary control concepts and automation technologies 2. Fundamentals of measuring with the focus on measurement principles, SI units, analogue measurement technology (fundamentals, measurement bridges, lock-in measurement technique, quadrature demodulation technique, measurement of transit times and distances) and statistical measurement data evaluation (calculation of standard deviation and confidence intervals, propagation of the measurement uncertainty, setup of uncertainty budget for measurement) Objectives: Having successfully completed the modules, the students 1. understand fundamental behaviour description forms for technical systems. Further, they master the basic theoretical and computer-aided handling of linear, time-invariant and discrete-event behaviour models for the control of technical systems. They are able to design control algorithms for simple tasks. 2. are familiar with the principles of analogue measuring procedures and are able to evaluate measurement results by using statistical methods. They are able to calculate and interpret random and systematic measuring uncertainties.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in basic modules on Physics	
Usability	This module is a compulsory module within the *Diplom* degree programmes in Electrical Engineering, Mechatronics and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 210 minutes.	
ECTS credit points and grades	5 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	

Workload	150 hours
Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
MT-12 01 23	Micro Computer Engineering /Embedded Controller (*Mikrorechentechnik / Embedded Controller*)	Prof. Dr.-Ing. habil. L. Urbas
Contents and objectives	Content: - Computer architecture, instruction set architecture - Coupling with industrial processes - Instruction set oriented programming (Assembler) - Efficient and portable programming of data structures and algorithms in a typed procedural language (e.g. C) - Object-oriented analysis, design and generic implementation of data structures and algorithms on the basis of examples of Electrical Engineering and Information Technology (e.g. C++) - advanced knowledge of principles and possible fields of applications and employment of embedded controller architectures Objectives: The students: 1. are able to formulate and implement basic data structures and algorithms in a procedural language in an instruction set architecture specific language (assembler) as well as portable in a higher level programming language (e.g. C) 2. are able to analyse complex issues by using object-oriented structuring and modelling methods, to transfer them in algorithms and data structures and to implement them in a suitable language (e.g. C++) 3. know the interactions of different architectural concepts of controller cores with peripheral units in the overall system design. They are able to recognize and to evaluate the potential of different concepts, to design systems with embedded controllers and to program embedded controllers with their coupling to external devices.	
Modes of teaching and learning	5 SWS lecture, 4 SWS lab course, and self-study	
Prerequisites	Competences acquired in basic modules on computer science	
Usability	This module is a compulsory module within the *Diplom* degree programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of graded lab course (PL1) on objective 1 and 2 as well as a written exam (PL2, 120 min.) and a lab course (PL3, not graded) on objective 3.	
ECTS credit points and grades	10 ECTS credit points The module grade M is calculated as follows: M = (3PL1 + 2PL2)/5	
Frequency	Annually, module starts in the winter semester	
Workload	300 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
MT-12 02 21 RES-G10	Circuit Design (*Schaltungstechnik*)	PD Dr.-Ing. habil. V. Müller
Contents and objectives	Content: The module deals with the mode of operation, dimensioning and characteristics of electronic circuits of analogue and digital technology. Based on the circuit properties of diodes and transistors, much attention is paid to the analysis of basic circuits in the low frequency range. Analysis of basic circuits in the low frequency range on the basis of circuit properties of diodes and transistors Objectives: The students are able to dimension simple transistor circuits. They are able to analyse complex circuits on the basis of familiar properties of elementary circuits, they are familiar with the methodology of the design of amplifier circuits in the time and frequency domain. Further, they master the analysis and design of digital control and signal processing based on combinatorial and sequential circuit assemblies.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Competences acquired in basic modules on Physics as well as in modules such as MT-12 08 01 Fundamentals of Electrical Engineering, MT-12 09 01 Systems Theorie and MT-12 01 02 Automation Engineering and Measurement	
Usability	This module is a compulsory module within the *Diplom* degree programmes in Mechatronics and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment is a written exam (120 min).	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-12 02 22 (RES-H05)	Power Electronics (*Leistungselektronik*)	Prof. Dr.-Ing. St. Bernet
Contents and objectives	Content: 1. Structure and mode of operation of active power semiconductor components and power diodes, 2. analysis of the functioning of line and self-guided circuits, 3. simplification of the systems under consideration for the purpose of simulation, 4. interpretation of the core components of the power electronics subsystem, 5. modulation methods for controlling power electronic regulator control elements Objectives: The students 1. are familiar with the mode of operation and methods for the analysis of basic power electronic topologies and semiconductor components 2. are able to select and dimension appropriate circuits. Further, they are able to select and interpret power semiconductor devices for power electronic systems in typical applications. 3. are able to verify the basic function of the observed power electronic subsystem with means of simulation tools.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 1 project, and self-study	
Prerequisites	Competences acquired in modules such as MT-12 08 01 Fundamentals of Electrical Engineering	
Usability	This module is a compulsory module within the *Diplom* degree programmes in Mechatronics and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a project (P, 10 weeks) and a written exam (K, 120 min).	
ECTS credit points and grades	4 ECTS credit points The module grade M is calculated as follows: M= (4K + P)/5	
Frequency	Annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 04 01 (MT-12 04 01 RES-G09)	Electrical Power Engineering (*Elektroenergietechnik*)	Prof. Dr.-Ing. P. Schegner
Contents and objectives	Contents: - Generation, transformation, transport, distribution and usage of electrical energy - Structure of electrical energy supply - Fundamentals of three-phase power and their mathematical description - Electrical safety and coordination of stress and strength - Fundamentals of power electronics - Electromechanic energy converters Objectives: Having successfully completed this module, the students are able to undertake basic calculations and measurements for simple three-phase systems. They are familiar with principles of safety measures in electrical networks. They are able to calculate simple insulation configurations. The students are familiar with the fundamental mode of operation of power electronic circuits, electrical machines and three-phase transformers.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	None	
Usability	The module is a compulsory module for the basic studies in the *Diplom* programmes in Electrical Engineering, Mechatronics, and Renewable Energy Systems. It provides various tools for the passing of the modules within the the main studies.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 min. (PL1) and a lab course (PL2). Both elements of assessment have to be passed.	
ECTS credit points and grades	5 ECTS credit points The module M grade is calculated as follows: M = (2PL1 + PL2)/3	
Frequency	annually, in the winter semester	
Workload	150 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 05 01 (MT-12 05 01 RES-G19)	Electronic Systems Design *(Geräteentwicklung)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	Content: The module focuses on constructional fundamentals with technical illustration and CAD, device design and device requirements, reliability of electronic systems, thermal dimensioning and electromagnetic compatibility. Objectives: Students completing this module obtain basic knowledge for the construction and development of electronic assembly groups and devices. They will have an understanding of engineering tasks as well as related requirements. Thus, the students will be enabled to follow engineering principles while developing and constructing such products under consideration of all relevant aspects.	
Modes of teaching and learning	2 SWS lectures, 2 SWS tutorial, and self-study	
Prerequisites	none	
Usability	This module is a compulsory module for the basic studies within the *Diplom* programmes in Electrical Engineering, Mechatronics, and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment is conducted as a written exam (120 minutes).	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, during the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 08 01 (MT-12 08 01 RES-G06)	Fundamentals of Electrical Engineering (*Grundlagen der Elektrotechnik*)	Prof. Dr.-Ing. habil. R. Merker
Contents and objectives	Content: The calculation of direct current (DC) electrical networks Objectives: Having successfully completed this module, the students have basic knowledge of electrical engineering and electronics and master methods for solving electrical engineering problems as a basis for further modules. The focus is on resistive circuits. Students are able to describe linear and nonlinear two poles and to consider the temperature dependence of their parameters, to analyze systematically electrical DC circuits and to apply simplified analysis methods (two pole theory, superposition theorem). They are able to calculate the power dissipation in circuits as well as to analyze and determine their thermal behaviour.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Basic knowledge in mathematics and physics from higher education	
Usability	The module is a compulsory module of the basic studies in the *Diplom* degree programmes in Mechatronics, and Renewable Energy Systems. It is designed to enable the students to pass the module exam of the module Dynamic Networks.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 minutes.	
ECTS credit points and grades	6 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the winter semester	
Workload	180 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-12 08 23 (RES-G07)	Electric and Magnetic Fields (*Elektrische und magnetische Felder*)	Prof. Dr.-Ing. habil. R. Merker
Contents and objectives	Content: The modules deals with the fundamenals for calculating basic electric and magnetic fields Objectives: After successfully completing this module, the students are able to master fundamental terms, concepts and methods for the calculation of basic electric and magnetic fields. They are able to calculate the stored field energy, force effects, and induction phenomena of magnetic fields. They are familiar with the basic principles of the electronic components resistor, capacitor, inductor, and transformer.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences acquired in modules on Principles of Algebra and Analysis and basic modules on Physics as well as competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering	
Usability	The module is a compulsory module of the basic studies in the *Diplom* degree programmes in Mechatronics and Renewable Energy Systems. It is designed to enable the students to pass the module exam of the module *Dynamic Networks*.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The module assessment consists of a written exam of 150 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the written exam.	
Frequency	annually, in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-12 08 03 (RES-G08)	Dynamic Networks (*Dynamische Netzwerke*)	Prof. Dr. phil. nat. habil. R. Tetzlaff
Contents and objectives	Content: The calculation of linear dynamic networks and measurements on electronic circuits, also with computer-controlled measurement technology Objectives: After completing this module, students master methods for the analysis of linear dynamic circuits excited by periodic signals or in the transient behaviour of stationary states. They are able to describe, to model and to calculate linear two-ports. They are able to determine the transfer function, to analyze and graph the behaviour in the frequency domain, to calculate simple filters. They master phasor representations and frequency response loci. The students also master the handling of electronic measuring devices and computer-controlled measuring technology. They have extensive skills and experience in the design and execution of experiments, in the evaluation and presentation of test and measurement results, in the assessment of measurement methods and measurement uncertainties as well as in writing a report/taking of minutes.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules on Principles of Algebra and Analysis, Multivariable Calculus and basic modules on Physics as well as competences acquired in modules such as ET-12 08 01 Fundamentals of Electrical Engineering	
Usability	The module is a compulsory module within the basic studies in the *Diplom* programme in Mechatronics and Renewable Energy Systems. It is designed to enable the students to pass the basic studies.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 150 minutes (PL1) and a lab course (PL2). Both assessments must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2PL1 + PL2)/3	
Frequency	annually, starting in the winter semester	
Workload	210 hours	
Duration	2 semester	

Module number	Module name	Lecturer in charge
MT-12 08 25	Measurement and Sensor Techniques/Actuators (for module part *Mess- und Sensortechnik*, for module part *Aktorik*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	Content: Time or frequency measurement with digital counters; analogue to digital conversion; noise as a stochastic process; regression analysis; sensors for electrical and non-electrical quantities; motion control; electrical actuator; operating principle, project planning, modelling of fluidic main components and systems Objectives: Having successfully finished this module, the students master the methodological fundamentals of 1. principles of digital measurement techniques and electrical sensors for detecting positions, velocities, forces and temperatures as well as calculation methods for measurement uncertainty using statistical methods and considerung noise processes. 2. principles and calculation methods for characterizing the design of electrical and hydraulic drives as basic elements for motion control.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in basic modules on Physics as well as in modules such as MT-12 04 01 Electrical Power Engineering, MT-12 09 01 Systems Theory, and MT-12 01 02 Automation Engineering and Measurement	
Usability	The module is a compulsory module within the basic studies in the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 120 min.) and a lab course (P1) on objective 1 as well as a written exam (K2, 120 min.) and a lab course (P2) on objective 2.	
ECTS credit points and grades	The module grade M is calculated as follows: M = (4K1 + P1 + 2K2 + P2)/8	
Frequency	Annually, starting in the winter semester	
Workload	270 Stunden	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
ET-12 09 01 (MT-12 09 01)	Systems Theory (*Systemtheorie*)	Prof. Dr.-Ing. E. Jorswieck
Contents and objectives	Content: The module deals with the fundamentals of systems theory with focus on digital systems, analogue time-continuous systems, analogue time-discrete systems and selected applications. Objectives: Having successfully completed the module, the students are familiar with the regulative significance of the system concept in engineering. They master the application of signal transformations for the effective description of the system behaviour in the area of image. In particular, they are able to apply the approach of system theory to important areas of their own discipline, e.g. to the calculation of electrical networks in the case of non-sinusoidal or stochastic excitation and to the realization of systems with desired transfer behaviour in time-discrete form (digital filter).	
Modes of teaching and learning	4 SWS lecture and 3 SWS tutorial and self-study	
Prerequisites	Competences acquired in modules on Principles of Algebra and Analysis and on Multivariable Calculus Competences acquired in modules such MT-12 08 01 Fundamentals of Electrical Engineering, and MT-12 08 23 Electric and Magnetic Fields	
Usability	The module is a compulsory module within the basic studies for the *Diplom* programme in Electrical Engineering and Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment is a written exam of 120 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, beginning in the winter semester	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
MT-13 01 02 (RES-G15)	Fundamentals of Kinematics and Kinetics (*Grundlagen der Kinematik und Kinetik*)	Prof. Dr.-Ing. habil. V. Ulbricht
Contents and objectives	Content: The module focuses on: - Kinematics of the point and the rigid body - Kinetics of rigid bodies in translation - Kinetics of a rigid body with arbitrary motion, momentum and angular momentum balance (including cutting principle, static interpretation of the momentum balances, free planar motion - Vibrations of systems with different degree of freedom - Lagrange equations of the second kind - Spatial rotor movements Objectives: The students are familiar with analytical methods for the analysis of rigid body motions, including the causative loads.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Knowledge in the fields of of Algebra and Analysis and Multivariable Calculus as well as competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics	
Usability	The module is a compulsory module within the basic studies for the *Diplom* programme in Mechatronics and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment is a written exam of 120 minutes.	
ECTS credit points and grades	5 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, in the winter semester	
Workload	150 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-13 01 04	Kinematics and Materials of Mechanics, Advanced (*Vertiefung Kinematik und Festigkeitslehre*)	Prof. Dr.-Ing. M. Beitelschmidt
Contents and objectives	Content: The module deals with in-depth topics of materials of mechanics, in particular energy methods, multiaxial stress states and linear elastic problems, deepening of the spatial kinematics and kinetics of the rigid body as well as an introduction to the mechanics technique. Objectives: Having successfully completed this module, the students master the spatial statics and the general theory of bending of the beam. They are familiar with general states of stress and strain. They master energy methods such as Castigliano's theorem and have an insight into the method of finite elements. They are able to calculate rotationally symmetric states of stress and to evaluate these by means of strength theories. Furthermore, they are familiar with the general basic equations of linear elasticity theory. The students master the description of the spatial kinematics of coordinate systems and rigid bodies with the help of transformation matrices and vectors. They are able to set up and apply equations of motion of rigid body motion. The students master the fundamentals of design, structure and kinematic analysis of simple planar mechanisms.	
Modes of teaching and learning	3 SWS lecture, 3 SWS tutorial, and self-study	
Prerequisites	Knowledge in the fields of Physics, Algebra and Analysis and Multivariable Calculus as well as competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-13 01 03 Fundamentals of Kinematics and Kinetics	
Usability	The module is a compulsory module within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment is a written exam of 180 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-13 12 01 (RES-G20)	Construction and Manufacturing Engineering (*Konstruktion und Fertigungstechnik*)	Prof. Dr.-Ing. B. Schlecht
Contents and objectives	Content: The module covers the fundamentals of the calculation of the load bearing capacity of simple components and also includes the variety of manufacturing processes in mechanical engineering, vehicle and plant construction by means of product and process examples. It integrates engineering thinking and working methods in the manufacturing process as well as the interaction with other disciplines. Objectives: Having successfully completed this module, the students 1. are familiar with and master the methodological fundamentals for the development, design, manufacturing and testing of mechanical engineering products as well as have skills in handling CAD systems. They are able to assess, select and calculate the application areas of typical machine elements such as axes and shafts, elemental compounds, positive-mode shaft-hub connections, rolling bearings, plain bearings and spur gearing. 2. know which divisions of a company are involved in the manufacturing of products, which requirements of the product determine the manufacturing possibilities as well as how decisions regarding production are derived. They know the manufacturing processes, in particular its active principles, the technical equipment and the technological parameters that are to be determined.	
Modes of teaching and learning	5 SWS lecture, 3 SWS tutorial, and self-study	
Prerequisites	Knowledge in the fields of Physics, Algebra and Analysis and Multivariable Calculus as well as competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-12 05 01 Electronic Systems Design	
Usability	The module is a compulsory module within the *Diplom* programme in Mechatronics and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 180 min.) and an assignment on objective 1 as well as a written exam (K2, 90 min.) on objective 2. All elements of assessment have to be passed.	
ECTS credit points and grades	10 ECTS credit points The module grade M is calculated as follows: M = (4K1 + 3K2 + 3B)/10	
Frequency	Annually, starting in the winter semester	
Workload	300 hours	

Duration	2 semesters

Module number	**Module name**	**Lecturer in charge**
MT-13 01 01	Field Theory (*Feldtheorie*)	Prof. Dr.-Ing. T. Wallmersperger
Contents and objectives	Content: 1. Kinematics of material continua, 2. selection of useful field variables, 3. global and local balance of mechanics, thermodynamics and electrodynamics, 4. theory of material equations, 5. examples for solving initial / boundary value problems Objectives: Having successfully completed the module, the students master the fundamental correlations for the mathematical description of mechanical, thermal, electrical and magnetic phenomena in deformable materials as the basis for analytical and numerical calculations of space and time, which are essential for the function of components.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences in Physics, Algebra and Analysis, Multivariable Calculus, Function Theory / Partial Differential Equations and Probability Theory as well as competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 02 Fundamentals of Kinematics and Kinetics, MT-13 01 04 Kinematics and Materials of Mechanics, Advanced, MT-12 08 01 Fundamentals of Electrical Engineering and MT-12-08 23 Electrical and Magnetic Fields	
Usability	The module is a compulsory module within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment is a written exam (150 min.).	
ECTS credit points and grades	5 ECTS credit points The module grade is the grade of the written exam.	
Frequency	Annually, in the summer semester	
Workload	150 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-13 01 02	Numerical Methods/System Dynamics (*Numerische Methoden/Systemdynamik*)	Prof. Dr.-Ing. M. Beitelschmidt
Contents and objectives	Content: Numerical methods - FEM/REM, system dynamics and practical exercises for the application of FEM and experimental mechanics Objectives: Having successfully completed this module, the students: 1. have knowledge and skills for the approximate solution of boundary value problems and coupled initial-boundary value problems based on the mathematical methods of weighted residuals, the weak and inverse formulation. They are familiar with the necessary algorithms for algebraing and discretisation, including the associated numerical methods. 2. master the system theoretic fundamentals of mechanic systems and their modelling with structure models. They know special problems on simple multi-body-mechanism with their specifics. 3. have an overview of the theory of linear oscillations with finite degrees of freedom, of the treatment of free and fettered torsional frequency response system of the drive dynamics, of bending vibrations with consideration of the gyroscopic effect. They are familiar with the fundamentals of modal analysis as well as special procedures for estimating natural frequencies and mode shapes. 4. have practical skills to apply modern methods of measurement and FEM software to determine and simulate the behaviour of mechanical structures under static and dynamic loading.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences in the fields of Physics, Algebra and Analysis, Multivariable Calculus, Function Theory / Partial Differential Equations and Probability Theory as well as competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-12 08 01 Fundamentals of Electrical Engineering	
Usability	The module is a compulsory module within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam (K1, 120 min.) on objective 1, a written exam (K2, 120 min.) on objective 2 and 3 and two lab course reports (P) on objective 4.	
ECTS credit points and grades	9 ECTS credit points The module grade M is calculated as follows: M = (2K1 + 2K2 + P)/5	
Frequency	Annually, beginning in the winter semester	

Workload	270 hours
Duration	2 semesters

Module number	**Module name**	**Lecturer in charge**
MT-12 13 01	Control of Continuous-Time Processes and Discrete Event Systems (*Regelungstechnik und Ereignisdiskrete Systeme*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: Fundamentals of control of linear systems (basic structures of control, signal and system descriptions, stability analysis, controller design in the frequency range), fundamentals of behavioural description of discrete event systems (signal-based, finite automata, Petri nets) and for the design of discrete event control systems (bottom-up, top-down automata and Petri nets), examples of laboratory-based control systems Objectives: Having successfully completed the module, the students 1. understand the basic structure of controls. They are able to describe linear systems mathematically and to analyse these with regard to their stability. Further, they are able to design single-loop linear controllers. 2. understand fundamental behavioural description forms for discrete event systems, they master the theoretical and computer-assisted handling of discrete event behaviour models and are able to design independently discrete event control algorithms for manageable tasks. 3. are able to solve control problems on real technical-physical systems.	
Modes of teaching and learning	5 SWS lecture, 2 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as MT-12 09 01 Systems Theory, and MT-12 01 02 Automation Engineering and Measurement	
Usability	The module is a compulsory module within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam (K1, 120 min.) on objective 1, a written exam (K2, 90 min.) on objective 2 and a lab course (P) on objective 3.	
ECTS credit points and grades	9 ECTS credit points The module grade M is calculated as follows: M = (4K1 + 4K2 + P)/ 9	
Frequency	Annually, starting in the winter semester	
Workload	270	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
ET-13 00 01 (MT-13 00 01 RES-G14)	Materials and Engineering Mechanics (*Werkstoffe und Technische Mechanik*)	Prof. Dr.-Ing. habil. J. Bauch
Contents and objectives	Content: Materials with focus on: 1. Overview of materials in Electrical Engineering and Mechatronics, practical examples 2. Fundamentals of materials science 3. Status diagrams and alloys 4. Conductor, semiconductor, dielectric and magnetic materials 5. Materials testing and diagnostics Statics and science of strength of materials with focus on: 1. Rigid bodies 2. Independent loads, power and torque, method of sections 3. Balance of planar structures (balances of forces and moments) 4. Tensile, compressive and shear stresses including elementary dimensioning concepts 5. Torsion of bars with circular cross-section, straight bending of prismatic beams, strength theories and bar buckling Objectives: Having successfully completed this module, the students are familiar with the interrelation between the microscopic structure, the macroscopic properties and the practical aspects of application of materials. They know the theoretical principles of the atomic structure, the bond type, the crystal structure, the real structure as well as the microstructure and are familiar with material testing. Further, they are familiar with the fundamental laws of statics as well as the simplified interrelation between loads, material properties and loads of components. With regard to these topics, they master calculation methods of the structural design and strength evaluation.	
Modes of teaching and learning	4 SWS lecture, 3 SWS tutorial, and self-study	
Prerequisites	Knowledge in mathematics and physics from higher education	
Usability	The module is a compulsory module within the basic studies of the *Diplom* programme in Mechatronics, Electrical Engineering and Renewable Energy Systems.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of a written exam of 90 min. (K1) and a written exam of 120 min. (K2, 120 min.). Both elements of assessment must be passed.	

ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3PL1 + 4PL2)/7
Frequency	Annually, starting in the winter semester
Workload	210 hours
Duration	2 semesters

Module number	Module name	Lecturer in charge
MT-M01-G	Multi Body Systems, Basics (*Mehrkörpersysteme, Grundlagen*)	Prof. Dr.-Ing. M. Beitelschmidt
Contents and objectives	The method of multi-body system simulation is an established technique to calculate large movements of mechanical systems consisting of rigid and elastic bodies in the time domain. It is applied in general mechanical engineering, the automotive and aerospace engineering. The coupling with control technology is required in mechatronic systems in particular. The students 1. master the methodology of movement equations of multi body systems as well as their computer-assisted implementation for simple special cases 2. are familiar with the various algorithms of multi body simulation that are applied in commercial programmes and 3. understand the theoretical fundamentals of elastic multi body systems and are able to prepare elastic bodies from FE models for simulation in multi body programmes.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences in the field of Engineering Mechanics that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 03 Fundamentals of Kinematics and Kinetics, and MT-13 01 02 Numerical Methods/System Dynamics Competences in Principles of Algebra and Analysis, Multivariable Calculus, Function Theory / Partial Differential Equation, Probability Theory	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics. It lays the foundation for the module Multi Body Systems, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. If more than 15 students register for the module assessment, the module assessment is a written exams (180 min.). If 15 students register for the module assessment, the module assessment is an individual oral exam (45 min.).	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the assessment.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M01-V	Multi Body Systems, Advanced (*Mehrkörpersysteme, Vertiefung*)	Prof. Dr.-Ing. M. Beitelschmidt
Contents and objectives	Content: Method of multi-body simulation in order to be able to calculate large movements of mechanical systems of rigid and elastic bodies in the time domain. This established procedure is generally used in mechanical engineering as well as vehicle and aerospace engineering. For mechatronic applications, the coupling with control technology as well as with simulation models of other physical domains and the real-time simulation is necessary. Objectives: Having successfully completed the module, the students master the methodological fundamentals for the solution of control engineering of multi body systems, they are familiar with the fundamentals of coupled simulation as well as the real-time simulation and are able to implement controller for simple multi-body systems. They are able to use a commercial multi-body systems simulation programme, especially to independently create models, to execute simulation calculations and to prepare results and interpret them.	
Modes of teaching and learning	3 SWS lecture, 3 SWS tutorial, and self-study	
Prerequisites	Competences in computer science, control and event discrete systems as well as competences that can be acquired on modules such as MT-M01-G Multi Body Systems, Basics	
Usability	This module is an elective module of the group “methods” within the Diplom programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. If more than 10 students register for the module assessment, the assessment is a written exam (K1, 150 min.) and an assignment (PL3). If 10 students or less register for the module assessment, the assessment consists of 2 indivdual oral exams (PL1 and PL2, 30 min. each) and an assignment (PL3).	
ECTS credit points and grades	7 ECTS credit points. The module grade M is calculated as follows: M = (9K1 + PL3)/10 (in the case of more than 10 registered students) or M = (9PL1 + 9PL2 + 2PL3)/20 (in the case of 10 registered students or less)	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-M02-G	Fluid Power Systems, Basics (*Fluidtechnische Systeme Grundlagen*)	Prof. Dr.-Ing. J. Weber
Contents and objectives	Content: System structures and components of modern regulated electro-hydraulic drives, which are used in e.g. presses, plastics machines or machine tools. The necessary control and regulation concepts, the possibilities of control description and the methods for the design of the corresponding control circuits are treated. Furthermore, the structures and components of pneumatic drive systems, which are mainly used for automated handling tasks of industrial goods, are presented. Another focus is the design of process control and their implementation in pneumatic circuits. Particular attention is paid to electropneumatic solutions involving programmable logic controllers (PLCs). Practical experiments on the control of hydraulic and pneumatic drives serve to deepen and apply the acquired knowledge. Objectives: After completing the module, the students master the methodical fundamentals for the control and regulation analysis of electrohydraulic and pneumatic drive systems. They are able to design the corresponding control loops. They are able to design sequence control systems and convert them into pneumatic circuits.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences in mathematics (Principles of Algebra and Analysis, Multivariable Calculus), physics, and control	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics. It lays the foundation for the module Fluid Power Systems, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1, K2, 120 min. each) and a lab course (P).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2K1 + 2K2 + P)/5	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M02-V	Fluid Power Systems, Advanced (*Fluidtechnische Systeme Vertiefung*)	Prof. Dr.-Ing. J. Weber
Contents and objectives	Content: System architectures and components of hydraulic drives and controls in mobile work machines. Methods for the selection of drives that meet the requirements and dimensioning are taught. The focus is on systems of working hydraulics, traction drive systems and steering systems. Due to the increasing use of electro-hydraulic systems in mobile work machines, the module also deals with control, software development and safety aspects. Practical experiments on the functional and energetic behaviour of typical systems of mobile hydraulics as well as on the implementation of control algorithms are carried out to apply and deepen the acquired knowledge.. Objectives: Having successfully completed this modules, the students will be able 1. to select components and systems for mobile work machinery according to their requirements and to dimension these, as well as 2. to assess not only the functional design of the hydraulic systems but also necessary aspects of machine safety and to implement the control of the systems by means of microprocessors.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as MT-M02-G Fluid Power Systems, Basics Basic knowledge on the methods of control engineering that can be acquired in modules such as MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 120 min.) on objective 1, a written exam (K2, 90 min.) on objective 2 and a lab course (P) on objective 1 and 2.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3K1 + K2 + P)/5	
Frequency	Annually, in the winter semester	
Workload	210 hours	

Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
MT-M03-G	Mechanical Construction, Basics (*Maschinenkonstruktion Grundlagen*)	Prof. Dr.-Ing. habil. R. Stelzer
Contents and objectives	Content: The mechanical material behaviour under quasi-static and cyclic loading as well as the application of construction materials at high temperatures and under aggressive media. The focus is on metallic construction materials, their material choices (e.g., high strength, weldability, machinability, formability, castability), and selected material developments for the mechanical, plant and vehicle construction. Furthermore, the module contains the fundamentals and methods for the development of mechanical engineering products. It covers relevant business processes, legal foundations (machinery directive), technology development, strategic product planning, industrial property rights, quality assurance and release and change management. The important part is the product development process according to VDI 2221 (requirements specification, functional modelling, variant generation and evaluation) as well as the realization of a development project. Objectives: The students 1. are familiar with the most important construction materials and the possibilities of influencing their material properties and 2. are able to select and apply methods and tools of product development. The students can structure and plan product development processes.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course, and self-study	
Prerequisites	Knowledge and competences in physics and computer science Knowledge and competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-13 12 01 Construction and Manufacturing Engineering	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics. It lays the foundation for the module Mechanical Construction, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1 on objective 1, K2 on objective 2, 120 min. each), a lab course (P) and an assignment (B).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = ((4K1+ P)/5 + (2K2 + B)/3)/2	
Frequency	Annually, starting in the summer semester	

Workload	210 hours
Duration	2 semesters

Module number	Module name	Lecturer in charge
MT-M03-V	Mechanical Construction, Advanced (*Maschinenkonstruktion Vertiefung*)	Prof. Dr.-Ing. habil. R. Stelzer
Contents and objectives	Objectives The focus of the module is on 1. "Synthesis and analysis of product models" (SAP) and 2. Product Data Management (PDM) Through SAP, the students are enabled to program functions within a CAD system and to work with the internal data of the CAD model. In particular, models that cannot be generated interactively are to be generated. Furthermore, the students are able to analyze parts and assemblies in an automated manner and to determine information (e.g. manufacturing-relevant dimensions, assembly structures, data from motion simulations). Students can also develop programs to transfer data between the CAD system and other applications. Through PDM, students are enabled to understand and analyze tasks and processes of data management in the development process. Using a PDM system, they are able to check in models generated in CAD, to analyze and contruct document and article structures. Content: 1. Selected methods and tools for the automated synthesis and analysis of CAD models. The focus is on data structures and functions for manipulating the internal 3D model of a CAD system. With the help of an API, programmes for the automated generation of geometry and analysis of existing assemblies are developped. In addition to the development of CAD internal functions, the interfaces between CAD and other software products such as Excel and MathCAD are discussed. 2. Principles and concepts of product data management for the control of product and process complexity in mechanical engineering. Models and methods for the organization and administration of product data (articles, documents, product structures) as well as the management of engineering-processes (e.g. release and change processes) are introduced. Emphasis is also on the introduction of PDM in the company, creation of product and process models, security aspects, CAD integration and collaborative engineering. Much importance is attached to the including of recent research. The handling of a PDM system is practiced.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, and self-study	

Prerequisites	Knowledge and competences that can be acquired in modules such as MT-13 12 01 Construction and Manufacturing Engineering and MT-M03-G Mechanical Construction, Basics as well as competences in computer science
Usability	This module is an elective module of the group "methods" within the Diplom programme in Mechatronics.
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of 2 written exams (K1 on objective 1, K2 on objective 2, 90 min. each exam)
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3K1 + 2K2)/5
Frequency	Annually, in the summer semester
Workload	210 hours
Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
MT-M04-G	Control, Basics (*Regelung und Steuerung Grundlagen*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: State space methods and sampling control Design and analysis of nonlinear control systems Objectives: Having successfully completed this module, the students understand the solutions of state space models in time and frequency domain, are familiar with the concepts of controllability and observability and are able to check these properties for given systems. They are able to design state controllers and state observers and understand the fundamentals of sampling control. They can deal with nonlinear control systems, the mathematical analysis of nonlinear systems and the dimensioning of simple controllers for nonlinear systems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Knowledge and competences in dynamic systems that can be acquired in modules such as MT-12 09 01 Systems Theory and MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems	
Usability	This module is an elective module of the group “methods” within the Diplom programme in Mechatronics. It lays the foundation for the module Control, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of 2 written exams (K1, K2, 120 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2)/2	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M04-V	Control, Advanced (*Regelung und Steuerung Vertiefung*)	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: Analysis and design of optimal and/or robust and/or nonlinear control systems System theoretical elements of complex control systems (e.g. spatially distributed systems) Objectives: The students master the methodical fundamentals for the analysis of complex control systems and the dimensioning of corresponding control facilities. They are able to model, analyse, actuate and control, by means of mathematical and system theoretical correlations, complex control systems (e.g. multivariable systems, systems with uncertainties, nonlinear systems, spatially distributed systems).	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Knowledge and competences that can be acquired in modules such as MT-12 09 01 Systems Theory and MT-M04-G Control, Basics	
Usability	This module is an elective module of the group "methods" within the Diplom programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of 2 written exams (90 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1+K2)/2	
Frequency	Annually, starting in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
MT-M05-G	Electric Drive Technology, Basics (*Elektrische Antriebstechnik Grundlagen*)	PD Dr.-Ing. habil. G.-H. Geitner
Contents and objectives	Content: The method of electric drive technology Objectives: Having successfully completed this module, the students are able to apply methods for the design and calculation of electric drive systems as well as to use various modelling tools for description, modeling and simulation. They master the internal processes in power electronic actautors, are able to model and to calculate these und understand their interaction with the electric drive and drive-related control systems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus) Competences that can be acquired in modules such as MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 04 01 Electrical Power Engineering, MT-12 02 22 Power Electronics, MT-12 01 02 Automation Engineering and Measurement and Control Engineering	
Usability	This module is an elective module of the group “methods” within the *Diplom* programme in Mechatronics. It lays the foundation for the module Electric Drive Technology, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1, K2, 120 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (4K1 + 3K2)/7	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-M05-V	Electric Drive Technology, Advanced (*Elektrische Antriebstechnik Vertiefung*)	PD Dr.-Ing. habil. G.-H. Geitner
Contents and objectives	Content: The fundamentals of electrical machines in structure, operating behaviour, performance, agitator speed, power controlling and energy efficiency: - Fundamentals of electromagnetic energy conversion - Transformers - DC machines - Synchronous machines - Induction machines - Small machines - Linear Motors - Testing of electrical machines Objectives: Having successfully completed the module, the students master the methodic principles of the structure and mode of operation of electrical machines. They are able to understand operating behaviour, agitator speed and power controlling as well as energy efficiency in detail.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus) Competences that can be acquired in modules such as MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 04 01 Electrical Power Engineering, MT-12 02 22 Power Electronics, MT-12 01 02 Automation Engineering and Measurement and MT-M05-G Electric Drive Technology, Basics	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (PL1, 90 min.) and lab course (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (4PL1 + 3PL2)/7	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M06-G	Process Control Engineering, Basics (*Prozessinformationsverarbeitung Grundlagen*)	Prof. Dr.-Ing. habil. L. Urbas
Contents and objectives	Content: Fundamentals, methods, algorithms and architectures for computer-assisted information generation, distribution, processing, display and use of near-process data. Objectives: Having successfully completed this moduel, the students master 1. the methodological fundamentals for the design and application of simple process-oriented information processing systems. They are able to plan, design, put into operation and test these systems in distributed automation structures. And they are able to 2. choose and evaluate appropriate communication structures and components for distributed systems and functions.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course, and self-study	
Prerequisites	Competences in principles of algebra and analysis, multivariable calculus, computer science, micro computer engineering /embedded controller	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics. It lays the foundation for the module Process Control Engineering, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The assessment consists of 2 written exams (PL1, PL2, 90 min. each) if more than 20 students register. If 20 students or less register, the assessment consists of 2 individual oral exams (PL1, PL2, 30 min. each). Further assessments: a graded lab course (PL4) on objective 1, a lab course (without a grade, PL3) on objective 2.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2PL1 + PL4 + 2PL2)/5	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M06-V	Process Control Engineering, Advanced (*Prozessinformationsverarbeitung Vertiefung*)	Prof. Dr.-Ing. habil. L. Urbas
Contents and objectives	Content: Principles and methods for taking into account the human factor in the analysis, evaluation and design of complex, interactive technical systems Objectives: The students master the fundamental methods of the human-machine-system technology for the description, analysis, evaluation and design of dynamic interactive systems and are able to deal systematically with the domain-specific issues of human-machine interaction.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS project, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-M06-G Process Control Engineering, Basics	
Usability	This module is an elective module of the group "methods" within the Diplom programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (PL1, 120 min.) and a project (PL2, 15 weeks).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2PL1 + PL2)/3	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M07-G	Design Techniques, Basics (*Entwurfstechniken Grundlagen*)	Prof. Dr. techn. K. Janschek
Contents and objectives	Content: 1.Elements of the physical modeling Energy-based modelling paradigms (Euler-Lagrange), tor-based modelling paradigms (generalized Kirchhoff's networks), signal-based modelling paradigms, differential algebraic equation systems 2. Elements of simulation technology Numerical integration of ordinary differential equation systems, differential algebraic equation systems (DAE) and hybrid (discrete event-continuous) systems of equations, modular simulation (signal-/object-oriented) 3. System design of mechatronic systems Multibody dynamics Mechatronic transducer principles Stochastic behaviour analysis System budget Objectives: The students 1. master the physical modelling paradigms and are able to create independently mathematical models, e.g. DAE-Systems. 2. are familiar with the basic structure of numerical integration algorithms and special features in their application for technical-physical systems. 3. are able to apply methods and tools of the physically based behaviour modelling and analysis (mechatronic systems) and are able to conduct an informed quantitative design evaluation and optimization.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-12 01 02 Automation Engineering and Measurement and MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics. It lays the foundation for the module Design Techniques, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of - a written exam (K1, 120 min.) on objective 1 and 2 - a written exam (K2, 120 min.) on objective 3	

ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2)/2
Frequency	Annually, starting in the winter or the summer semester
Workload	210 hours
Duration	2 semesters

Module number	Module name	Lecturer in charge
MT-M07-V	Design Techniques, Advanced (*Entwurfstechniken Vertiefung*)	Prof. Dr. techn. K. Janschek
Contents and objectives	Content: System design of complex automation systems, among others with the focus on requirements definition, function-oriented behaviour modelling, object-oriented behaviour modelling, safety-oriented design, quality assurance with the associated tasks and terms, the description of quality parameters (discrete/continuous and their parameters), the recording of quality data and their statistical verification, the use of quality control charts and process capability analysis, the analysis of reliability data, the execution of regression analysis and the use of quality standards. Objectives: Having successfully completed this module, the students are able to 1. work with the concepts, methods and tools of abstract behaviour modelling and analysis (complex automation systems). They are able to conduct an informed quantitative design evaluation and optimization. 2. apply fundamental methods of quality assurance.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus, Probability Calculation, Functional Theory, Partial Differential Equation)	
Usability	This module is an elective module of the group "methods" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of one written exam (K1, 90 min.) on objective 2 and a written exam (K2, 120 min.) on objective 1.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2)/2	
Frequency	Annually, starting in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
MT-A01-G	Automotive Vehicle Engineering, Basics (*Kraftfahrzeugtechnik Grundlagen*)	Prof. Dr.-Ing. G. Prokop
Contents and objectives	Content: The design, construction and operation of the components of a motor vehicle and their interaction for the realization of the overall properties of the vehicle. The module includes: - Functionality of components and subsystems of the vehicle - Design and dimensioning of the components - Interaction of the individual components and systems - Realization of the overall vehicle performance by means of specific design of components and systems Objective: Having completed the module, the student knows the individual functions of the components of the motor vehicle as well as their interaction in the overall vehicle. She/he is thus in a position to evaluate and optimize the overall vehicle performance.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Knowledge and competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 02 Numerical Methods/System Dynamics, MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 08 01 Fundamentals of Electrical Engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module Automotive Vehicle Engineering, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1 and K2, 90 min each.) and a lab course (not graded).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2)/2	
Frequency	Annually, beginning in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A01-V	Automotive Vehicle Engineering, Advanced (*Kraftfahrzeugtechnik Vertiefung*)	Prof. Dr.-Ing. G. Prokop
Contents and objectives	Content: Functional design of motor vehicles and mechatronic systems. The focus is on: modelling and simulation, development and release processes, mobility and vehicle concepts, driving dynamics and driving comfort, control systems in the motor vehicle and lightweight construction as well as ergonomics. Objectives: Having successfully completed this module, the students are able to design and realize component requirements, which are derived from the overall vehicle characteristics to be realized, on technical solutions.	
Modes of teaching and learning	6 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Knowledge and competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 02 Numerical Methods/System Dynamics, MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 08 01 Fundamentals of Electrical Engineering and MT-A01-G Automotive Vehicle Engineering, Basics	
Usability	This module is an elective module of the group "applications" within the Diplom programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of three written exams (K1 and K2 90 min. each, K3 120 min.)	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2 + K3)/3	
Frequency	Annually, beginning in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
MT-A02-G	Railway Vehicle Engineering, Basics (*Schienenfahrzeugtechnik Grundlagen*)	Prof. Dr.-Ing. G. Löffler
Contents and objectives	Content: The design, construction and production as well as maintenance of the subsystems brake and railway safety technology of track-guided vehicles. Objectives: Having successfully completed the module, the students understand the system structure of a railway vehicle, are familiar with the control engineering of the subsystems brake and railway safety system as well as of the overall system. They are also able to design and calculate subsystems.	
Modes of teaching and learning	4 SWS lectures and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 03 Fundamentals of Kinematics and Kinetics, MT-12 01 23 Micro Computer Engineering/Embedded Controller MT-12 01 02 Automation Engineering and Measurement and Control Engineering Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus, Functional Theory, Partial Differential Equation)	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment is a written exam (90 min.).	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade for the exam.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A02-V	Railway Vehicle Engineering, Advanced (*Schienenfahrzeugtechnik Vertiefung*)	Prof. Dr.-Ing. G. Löffler
Contents and objectives	Content: The design, construction and production as well as maintenance of the subsystems electric drive and multi-body dynamics of track-guided vehicles Objectives: Having successfully completed the module, the students understand the system structure of a railway vehicle. They are familiar with the structure and function of the electric vehicle drive and its main components, understand the interactions of electric vehicles with the power supply systems, are familiar with the control engineering of the subsystems and the overall system, are able to design and calculate subsystems, are able to model railway vehicles as a complete system using simulation technology.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 03 Fundamentals of Kinematics and Kinetics, MT-12 01 23 Micro Computer Engineering/Embedded Controller MT-12 01 02 Automation Engineering and Measurement and Control Engineering Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus, Functional Theory, Partial Differential Equation)	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment is a written exam (90 min.).	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade for the exam.	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A03-G	Combustion Engines, Basics (*Verbrennungsmotoren Grundlagen*)	Prof. Dr.-Ing. H. Zellbeck
Contents and objectives	Content: The thermodynamic calculation methods for simulating a combustion engine and the associated components (e.g., piping systems, exhaust gas turbochargers). In addition, the module deals with the theoretical description of the dynamics of the reciprocating engine with the focus on: compensatory measures, movement equations to characterization of torsional oscillator chains and calculation methods for their natural frequencies and eigenmode. Further module contents are: design and operation of test stands and measurement technology, the thermodynamic and emission-related analysis of the combustion engine, selected subsystems and the entire vehicle Objectives: Having successfully completed this module, the students are able to calculate a complete circuit of a combustion engine step by step, have a deeper understanding of the complex system behaviour of combustion engines and can create their own calculation models based on the acquired competency.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences in science and in fundamentals of electrical engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A03-V Combustion Engines, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1 and K2, 90 min. each) and a written exam of 120 min. (K3).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (5K1 + 2K2 + 3K3)/10	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A03-V	Combustion Engines, Advanced (*Verbrennungsmotoren Vertiefung*)	Prof. Dr.-Ing. H. Zellbeck
Contents and objectives	Content: Design and mode of operation of a combustion engine as well as physical and thermodynamic processes, pollutant generation and avoidance, control. In addition, the module deals with the technical scientific description of all essential electrical and electronic automotive system components and the methodological presentation of related development procedures. The main focus is on electrical wiring, generator, battery systems, electronic systems in power train, safety and convenience electronics as well as communication systems. Objectives: Having successfully completed this module, the students are able to evaluate and optimize the system behaviour of a combustion engine with the associated electronic control systems in the motor vehicle.	
Modes of teaching and learning	4 SWS lecture, 1 SWS lab course, and self-study	
Prerequisites	Competences in science and in fundamentals of electrical engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 90 min. (K1) and a written exam of 120 min. (K2). Further, the students have to take part in 3 lab sessions.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2)/2	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A04-G	Motion Control, Basics (*Bewegungssteuerung Grundlagen*)	PD Dr.-Ing. habil. V. Müller
Contents and objectives	Content: Motion controls determine the current possibilities and future developments in production, processing and transportation technology. The module therefore deals with the motion sequence and and interactions in the mechatronic system, which can be achieved with motion control of an axis and by linking several axes with communication structures in drive systems. Objectives: Having completed the module, the students are familiar with the methodic fundamentals for the design of motion control, especially with 1. the elements of the drive system: energy and information technology components as well as system integration of drives with complex mechanics 2. the converter supply of three-phase-drives and their control methods, interaction of actuator and motor 3. the design of quasi-continuous and discontinuous controllers for the application in motion control of electric drives.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 04 01 Electrical Power Engineering, MT-12 02 22 Power Electronics and MT-12 01 02 Automation Engineering and Measurement	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A04-G Motion Control, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (150 min.).	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade for the exam.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A04-V	Motion Control, Advanced (*Bewegungssteuerung Vertiefung*)	PD Dr.-Ing. habil. V. Müller
Contents and objectives	Content: Design principles and calculation methods for the design and use of mechatronic solutions for motion control as well as methods of computer-aided design. The lab course deepens the knowledge regarding important tasks of motion control. Objectives: Having successfully completed the module, the students know the current state of drive technology for the solution of problems of motion control. They also have skills and knowledge for the analysis and design of electric drive systems. They are able to solve design and analysis tasks on test stands and by means of simulation tools.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences in electric drive technology that can be acquired in modules such as MT-A04-G Motion Control, Basics Competences in control engineering that can be acquired in modules such as MT-12 01 02 Automation Engineering and Measurement and Control Engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 90 min.) and a lab course (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated as follows: M = (4K1 + 3PL2)/7	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A05-G	Aerospace Engineering, Basics (*Luft- und Raumfahrttechnik Grundlagen*)	Prof. Dr.-Ing. K. Wolf
Contents and objectives	Content: The module deals with the fundamentals of the application of fiber composite materials in aircraft and spacecraft with focus on mechanics of fiber composites, construction principles and construction methods. On the other hand, the module includes the fundamentals of position control of spacecraft with focus on pathway dynamics, position determination, position sensors and control concepts for position control and position stabilization. Objectives: Having successfully completed this module, the students are able to 1. understand the difference of mechanical behaviour between anisotropic and classical structural materials, 2. apply methods and design criteria for the construction of aerospace structures using fibre composite materials and 3. master the basic technical principles and system concepts for position control of spacecraft and to model, analyse, and interpret corresponding systems.	
Modes of teaching and learning	3 SWS lecture, 3 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-13 01 03 Fundamentals of Kinematics and Kinetics Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus)	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A05-G Aerospace Engineering, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of 1. a written exam (K1, 120 min.) on objective 1 and 2 2. a written exam (K2, 120 min.) on objective 3.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2K1 + K2)/3	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A05-V	Aerospace Engineering, Advanced (*Luft- und Raumfahrttechnik Vertiefung*)	Prof. Dr.-Ing. K. Wolf
Contents and objectives	Content: The module deals with the technical fundamentals for the design and construction of aircraft with special consideration of interdisciplinary aspects. Further, the module contains the fundamentals of the energy supply of space vehicles with focus on energy generation, regulation, conditioning, distribution and storage. Objectives: Having successfully completed this module, the students are able 1. to understand the design of aircrafts, the technology applied and the process of development, to apply the methods necessary for the design as well as to analyse system configurations in terms of performance and profitability, 2. to evaluate the autonomous and mobile energy conversion methods applied in spacecraft, to discuss requirements and to define development stages to a complete system.	
Modes of teaching and learning	4 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-13 01 03 Fundamentals of Kinematics and Kinetics, MT-A05-G Aerospace Engineering, Basics Competences in higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus)	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of to written exams (K1, K2, 90 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2K1 + 3K2)/5	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A06-G	Mobile Work Machines, Basics (*Mobile Arbeitsmaschinen, Grundlagen*)	Prof. Dr.-Ing. habil. T. Herlitzius
Contents and objectives	Content: The module deals with the requirements and fundamentals of mechanical engineering and mechatronics for the design, construction and application of off-road vehicle technology. The focus is on methodological knowledge of the function, design and dimensioning of mobile working machines, as well as the fundamentals for the analysis for the design of various drive and automation concepts. Objectives: The students 1. have acquired methodological knowledge of function, design and dimensioning of actuators and steering of mobile work and utility vehicles and are able to analyse and design different drive concepts of off-road vehicles. 2. understand the requirements on processes and machines of agriculture and gain skills and abilities for process understanding, automation strategies and operating mode of mobile machines. 3. are able to apply the knowledge described in 1. and 2. to complex machinery (tractors, harvester-threshers, loaders).	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics and MT-12 08 25 Measurement and Sensor Techniques/Actuators	
Usability	This module is an elective module of the group “applications” within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A06-G Mobile Production Machines, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 90 min.) and an oral exam in groups (30 min., up to 3 students).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + 2PL2)/3	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A06-V	Mobile Work Machines, Advanced (*Mobile Arbeitsmaschinen, Vertiefung*)	Prof. Dr.-Ing. J. Weber
Contents and objectives	Content: The module deals with examples for the modelling and simulation of elements, assemblies and work processes of mobile machines as well as the application of the modelling methods. In practical examples, selected simulation environments are used as calculation tools. Objectives: Having successfully completed the module, the students master the fundamentals of modelling and simulation of elements, assemblies and work processes of mobile work machines. They are able to set up model approaches to describe various technical problems. They are familiar with various simulation methods and the associated tools. They have the ability to program simple simulations, to perform simulation calculations as well as to prepare and interpret results. They have practical knowledge, experience and skills in the use of measuring instruments for subject-specific tasks.	
Modes of teaching and learning	2 SWS lecture, 2 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-12 08 25 Measurement and Sensor Techniques/Actuators and MT-A06-G Mobile Production Machines, Basics	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 90 min.) and a lab course (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2K1 + PL2)/3	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A07-G	Motion Controlled Machine Systems, Basics (*Bewegungsgeführte Maschinensysteme Grundlagen*)	Prof. Dr.-Ing. S. Ihlenfeldt
Contents and objectives	Content: 1. The mechatronic system character and the development potential of machine tools, 2. design and function of the main assemblies main drive and traverse drive system, control and rack as well as the interaction of mechanical, electrical and information processing components, 3. the specification, selection and dimensioning of the main assemblies, and 4. the determination and evaluation of the functionally relevant system behavior of motion-guided machine systems. Objectives: The students are familiar with the characteristic functions, requirements and technical solutions regarding motion controlled machine systems of production engineering for the realization of deforming and chipping processes of machining as well as tool and workpiece handling processes.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences in physics and higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus, Functional Theory, Partial Differential Equation, Probability Theory)	
Usability	This module is an elective module of the group “applications” within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A07-G Motion Controlled Machine Systems, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment is a written exam (120 min.).	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade for the written exam.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A07-V	Motion Controlled Machine Systems, Advanced (*Bewegungsgeführte Maschinensysteme Vertiefung*)	Prof. Dr.-Ing. S. Ihlenfeldt
Contents and objectives	Content: 1. Description of functionally relevant influences of the geometric-kinematic, static, thermal and dynamic behaviour of motion controlled machine systems, 2. modelling and calculation (FEM, simulation) of functionally relevant behavioural influences (statics, thermal, dynamics), and 3. experimental function and behavioural analysis on the assembly groups and systems of the following mechatronic application examples: a) position-controlled electro-mechanical traverse drive system, b) piezoelectric fine adjustment systems, c) actively magnetically supported machine tool main spindles; d) parallel kinematic systems of motion (hexapod). Objectives: Having successfully completed this module, the students have fundamental knowledge, methodological and practical skills on causes and effects, model description and calculation, as well as on targeted influencing and correcting the productivity and accuracy of the behaviour influencing production systems.	
Modes of teaching and learning	2 SWS lecture, 1 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences acquired in modules such as MT-A07-G Motion Controlled Machine Systems, Basics	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K, 150 min.) and a lab course (PL).	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated as follows: M = (7K + 3PL)/10	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A08-G	Robotics, Basics (*Robotik Grundlagen*)	Prof. Dr.-Ing. M. Beitelschmidt
Contents and objectives	Content: Robot kinematics, control of serial manipulators and guidance gear for robotics Objectives: Having successfully completed this module, the students master the methodology of calculating forward kinematics and inverse kinematics of typical robot configurations. They are familiar with the fundamentals of dynamics of robots as well as with the methodology and application for the control of robots.	
Modes of teaching and learning	5 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 03 Fundamentals of Kinematics and Kinetics and MT-13 01 02 Numerical Methods/System Dynamics, MT-12 01 23 Micro Computer Engineering/Embedded Controller Competences in physics and higher mathematics (Principles of Algebra and Analysis, Multivariable Calculus, Functional Theory, Partial Differential Equation, Probability Theory)	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A08-G Robotics, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. If more than 20 students are registered, the assessment comprises a written exam of 90 min. (PL1) and a written exam of 150 min. (PL2). If 20 students or less are registered, the module assessment comprises a written exam of 90 min. (PL1) and an individual oral exam of 30 min. (PL2).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2PL1 + 5PL2)/7	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A08-V	Robotics, Advanced (*Robotik Vertiefung*)	Prof. Dr.-Ing. habil. E. Beyer
Contents and objectives	Content: Overview of laser technology and industrial robots as well as the challenges of laser processes with robots. Types of robot programming are presented and tested in a practical example. Focus is on sensor applications: important fundamentals are taught as well as practical tasks assigned. Objectives: Having successfully completed this module, the students are familiar with the application of robots in the area of laser manufacturing engineering. They know how to program robots for production tasks, especially for laser applications and they are familiar with the fundamentals of autonomous robotics.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences in engineering mechanics that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics, MT-13 01 03 Fundamentals of Kinematics and Kinetics and MT-13 01 02 Numerical Methods/System Dynamics and MT-A08-G, Robotics, Basics	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam of 120 min. (K1) and a written exam of 90 min. (K2).	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated as follows: M = (4K1 + 3K2)/7	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A09-G	Specific Production Methods, Basics (*Spezielle Fertigungsmethoden Grundlagen*)	Prof. Dr.-Ing. habil. E. Beyer
Contents and objectives	Content: Physical fundamentals of plasma, plasma sources and plasma processes for various applications. Furthermore, the physical and technical fundamentals of lasers are taught as well as an insight into various laser processes is given. Ojectives: Having completed this module, the students: 1. are familiar with the structure and function of the main laser and plasma sources as well as the scientific and technological fundamentals of laser and plasma processes 2. are able to choose and implement suitable technology using mechatronic design principles in accordance with an identified profile of requirements.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences in physics and manufacturing engineering that can be acquired in basic modules on physics and in modules such as MT-13 12 01 Construction and Manufacturing Engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A09-V Specific Production Methods, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1 and K2, 90 min. each).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (4K1 + 3K2)/7	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A09-V	Specific Production Methods, Advanced (*Spezielle Fertigungsmethoden Vertiefung*)	Prof. Dr.-Ing. habil. E. Beyer
Contents and objectives	Content: The material science and technological foundations as well as characterization possibilities of nanotechnology and various fields of application. The methods for the rapid construction of three-dimensional structures from a wide variety of materials as well as with different methods are theoretically presented and practically demonstrated and tested. Lab courses are conducted on fundamentals, specializations, and special production methods. Objectives: Having successfully completed this module, the students 1. understand the materials science and technological fundamentals, requirements and characterization of nanotechnology and know its potential for a variety of fields of application. 2. know the possibilities of rapid product development and survey the width of processes of rapid prototyping processes / generative manufacturing technology. 3. are able to prepare components with commercial programs for the production by means of generative manufacturing technology as well as to set up and characterize these by means of appropriate processes. 4. have hands-on experience with various special production methods.	
Modes of teaching and learning	3 SWS lecture, 1 SWS tutorial, 2 SWS lab course, and self-study	
Prerequisites	Competences in science and competences that can be acquired in modules such as MT-A09-G Specific Production Methods, Basics	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1 and K2, 90 min. each) and graded lab course reports (PL3). The students have to take part in 7 lab sessions.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3K1 + 3K2 + PL3)/7	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
ET-12 05 07 (MT-A10-G)	Electronic Systems and Technolgy, Basics (*Gerätetechnik Grundlagen)*	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers Finite Element Method (FEM): 1. Fundamentals of modelling for the different physical domains of device technology using the example of structural mechanics, heat and electromagnetic fields, 2. generalized process steps for the creation of theoretically sound FEM models Thermal design: 1. Fundamentals of heat transport, 2. Thermal calculations and models Optimization: - Method of model creation and simulation, considering the holistic system-simulation approach for system design - Model experiments for the construction process (analysis, nominal value optimization, probabilistic optimization, multi-criteria optimization) Objectives: Students completing this module will obtain qualified fundamentals for systematic application of FEM tools. They understand the key concept of holistic system simulation for the design process. They are capable of finding robust and cost-effective solutions in system-design processes by applying system simulations while accounting for ubiquitous parameter variations and functional behaviour.	
Modes of teaching and learning	2 SWS lectures, 4 SWS tutorial, and self-study	
Prerequisites	Comptences that can be acquired by completing the module MT-12 05 01 Electronic Systems Design.	
Usability	This module is an elective module within the group "applications" for the *Diplom* programme in Mechatronics. .	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment consists of individual tutorial assignments.	
ECTS credit points and grades	7 ECTS credit point The module grade is determined by the grade obtained for the tutorial assignments.	
Frequency	Annually, during summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
ET-12 05 08 (MT-A10-V)	Electronic Systems and Technolgy, Advanced (*Gerätetechnik Vertiefung*)	PD Dr.-Ing. T. Nagel
Contents and objectives	Content: This module covers **1. Methodologies for Electromechanical Design** (Präzisionsgerätetechnik) with focus on: - Method of development - Construction guidelines and principles derived from technology and nature - Constructive guidelines for system design - Fundamentals for precision gears - Accuracy parameters for drive systems - Examples on development of precise-mechanics devices **2. Actuators** (*Aktorik*) with focus on: - Composition of drive systems - Properties of different small-drive systems and actuators - Servomotors for system design - Innovative actuators Objectives: Students completing this module will obtain qualified knowledge to develop and design modern precise-mechanics devices under consideration of general construction guidelines, design guidelines and failure-detection principles. They are furthermore familiar with relevant principles of actuators and their constructive mechanic. In combination with the knowledge of specific actuator properties, the students can chose actuators appropriately for different applications and requirements.	
Modes of teaching and learning	4 SWS lectures, 2 SWS tutorial, and self-study	
Prerequisites	Some specific expertise is required, which can be acquired by completing the module MT-12 05 01 Electronic Systems Design.	
Usability	This module is an elective module within the group "applications" for the *Diplom* programme in Mechatronics as well as an elective module for the *Diplom* programme in Electrical Engineering.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment comprises a written exam of 180 minutes (PL1) and tutorial assignments (PL2). Both elements of assessment must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (2PL1 + PL2)/3	
Frequency	Annually, during winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A11-G	Micro-Electro-Mechanical Systems, Basics (*Mikro-Elektro-Mechanische Systeme Grundlagen*)	Prof. Dr.-Ing. habil. U. Marschner
Contents and objectives	Content: The description of coupled multiphysical subsystems in the form of a common circuitry representation and their behavioural simulation. Simple mechanical, magnetic, fluidic (acoustic), electrical and coupled systems including their interactions are analysed. Complex problems of the design-accompanying optimization of the dynamic behaviour of electromechanical systems can be solved by combining the network simulation of electromechanical systems with the method of finite element modelling. Objectives: Having successfully completed this module, the students have fundamental methodological and practical knowledge of the effective design and the illustrative analysis of the dynamic behaviour of electro-mechanical and electro-magnetic systems as well as of the function and modelling of electromechanical transducersin sensors and actuators. They are familiar with the parameter determination using FEM methods and master the methodology of combining processes by means of virtual interface components. Students are thus able (1) to apply the clear and illustrative analysis methods of electrical networks, (2) to develop a better understanding of physics, (3) to design closed physically different subsystems and to use existing design software, e.g. SPICE, for the simulation.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, 1 SWS assignment, and self-study	
Prerequisites	Competences in physics that can be acquired in basic modules on physics Competences in mechanics that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics	
Usability	This module is an elective module within the group "applications" for the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment comprises a written exam of 120 min. (K) and an assignment (B).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3K + B)/4	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A11-V	Micro-Electro-Mechanical Systems, Advanced (*Mikro-Elektro-Mechanische Systeme Vertiefung*)	Prof. Dr.-Ing. A. Richter
Contents and objectives	Content: Fundamentals of the most important functional materials of microsystems technology including new functional materials, technological individual processes and microtechnologies, microsensors, microactuators, power supply of microsystems as well as selected applications of microsystems. Objectives: Having successfully completed this modules, the students: 1. master the physical fundamentals for the understanding of material properties and the interaction between them 2. know the material groups that are most important for microsystems technology and understand how they work 3. know the most important individual technological processes and micro technologies for the production of microsystems 4. know the operating principle of important micro-mechanical micro-sensors and micro actuators, 5. master various processes for the development of energy supply solutions for self-sufficient microsystems.	
Modes of teaching and learning	4 SWS lecture, 2 SWS lab course, and self-study	
Prerequisites	Competences in physics that can be acquired in basic modules on physics Competences in the area of materials that can be acquired in modules such as MT-13 00 01 Materials and Engineering Mechanics	
Usability	This module is an elective module within the group "applications" for the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1, K2, 90 min. each) and a lab course (PL3).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (7K1 + 7K2 + 6PL3)/20	
Frequency	Annually, starting in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	**Module name**	**Lecturer in charge**
MT-A12-G	Biomedical Engineering, Basics (*Biomedizintechnik Grundlagen*)	Prof. Dr.-Ing. H. Malberg
Contents and objectives	Content: 1. Fundamentals of physiology and medicine a) structure and function of cells and organs b) organ systems c) electro and neurophysiological fundamentals d) cardiovascular system e) autoregulation of the organism f) pathophysiological phenomena g) clinical functional processes 2. Measurement of physiological parameters a) measurement of electrical and non-electrical physiological parameters b) medical sensor technology c) artifacts and disturbances 3. Radiation application in medicine a) radiological diagnostics – X-ray, computed tomography, MRT b) nuclear medicine – principles, diagnostics and therapy with radionuclides c) - Radiotherapy - dose, radiation planning, radiation application Objectives: Having successfully completed this module, the students have basic knowledge of the construction and function of the human body with selected pathomechanisms that can be diagnosed and treated by medical technology, and essential features of the interface between the organism and technology as a basis for the use of diagnostic and therapeutic techniques. The students thus qualify for the interdisciplinary cooperation as engineers in the medical environment.	
Modes of teaching and learning	5 SWS lecture, 1 SWS tutorial, and self-study	
Prerequisites	Competences that can be acquired in basic modules on physics Competences that can be acquired in modules such as MT-12 08 01 Fundamentals of Electrical Engineering and MT-12 05 01 Electronic Systems Design	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A12-V Biomedical Engineering, Advanced.	

Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment is a written exam (90 min.).
ECTS credit points and grades	7 ECTS credit points The module grade is the grade for the exam.
Frequency	Annually, in the summer semester
Workload	210 hours
Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
MT-A12-V	Biomedical Engineering, Advanced (*Biomedizintechnik Vertiefung*)	Prof. Dr.-Ing. H. Malberg
Contents and objectives	Content: Biomedical Engineering a) fundamentals of medical engineering for diagnosis and therapy b) relevant physical, physiological and biochemical principles c) basic principles and design of medical devices d) diagnostic data acquisition e) automated processing of diagnostic signals and information f) therapeutic procedures g) organ support systems h) structure and function of life support systems i) technical aspects of medical devices in the laboratory test j) biomaterials, biocompatibility k) bionics 2. Diagnostic and therapeutic systems Structure and function of medical technical systems for diagnostics and therapy of a) the cardiovascular system, b) the sense organs, c) the musculoskeletal system, d) the urine conductive system and digestion, e) the peripheral and central nervous system. Objectives: Having successfully completed this modules, the students will be able to design and interpret systems for measuring physiological parameters taking into account the complex interactions between organism and technology. In addition, they can design automated systems for diagnosis and organ support and are familiar with the most important therapeutic medical technology procedures. They are able to transfer biological-physiological basic principles to technical areas.	
Modes of teaching and learning	3 SWS lecture, 2 SWS tutorial, 1 SWS lab course, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-A12-G Biomedical Engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	

Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of a written exam (K1, 120 min.) and a collection of 3 entrance tests and lab course reports (PL2).
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (7K1 + 3PL2)/10
Frequency	Annually, in the winter semester
Workload	210 hours
Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
MT-A13-G	Sensors and Measuring Systems, Basics (*Sensoren und Messsysteme Grundlagen*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	Objectives: The students are familiar with the fundamental principles as well as master the practical implementation of sensors and measuring systems. They 1. master the fundamental principles of measurement systems technology. They are familiar with process measurement technology as well as signal and image processing. They are able to apply the learned methods for industrial measurement systems, especially in automation engineering. 2. are able to assess the properties of real sensors (3S: sensitivity, selectivity, stability). They can detect and apply measurement methods in sensor technology and are familiar with sensors for the measuring of mechanical quantities and temperature. 3. are able to describe mechatronic laser measurement systems and to apply these in manufacturing, surface engineering, process control, biology and medical engineering.	
Modes of teaching and learning	4 SWS lecture, 2 SWS tutorial, and self-study	
Prerequisites	Competences in physics Competences that can be acquired in modules such as MT-12 09 01 Systems Theory, MT-12 01 02 Automation Engineering and Measurement and MT-12 08 25 Measurement and Sensor Techniques/Actuators	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics. It lays the foundation for the module MT-A13-V Sensors and Measuring Systems, Advanced.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of two written exams (K1, K2, 90 min. each) on objective 1 and 2 as well as an oral exam (PL3, 20 min.) on objective 3.	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated as follows: M = (3K1 + 2K2 + 2PL3)/7	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	**Module name**	**Lecturer in charge**
MT-A13-V	Sensors and Measuring Systems, Advanced (*Sensoren und Messsysteme Vertiefung*)	Prof. Dr.-Ing. habil. J. Czarske
Contents and objectives	Content: Pressure and temperature field measurement, speed measurement, particle size measurement, wall shear stress sensors, as well as the use and application of pressure, humidity, infrared, and gas sensors. Objectives: Having successfully completed this module, the students are familiar with the principles as well as master the practical implementation of sensors and measuring systems, especially for process, manufacturing, medical and fluid engineering. They 1. are familiar with the fundamental principles of laser sensors for the study of fluid flows. These include, e.g. camera based measurement methods, multi-dimensional velocity measurement methods (e.g. by means of an electronic Doppler frequency measurement) and measurement methods for particles. 2. are be able to apply sensors on the basis of different physical effects for applications, such as humidity, pressure and temperature measurement. 3. are able to conduct optical measurement methods under real conditions (disturbances, parameter variations, etc.). They are able to set up process measurement techniques and to characterize their measurement properties such as the temporal and spatial resolution and measurement uncertainty.	
Modes of teaching and learning	2 SWS lecture, 1 SWS lab course, 2 SWS project, and self-study	
Prerequisites	Competences in physics Competences that can be acquired in modules such as MT-12 09 01 Systems Theory, MT-12 01 02 Automation Engineering and Measurement, MT-12 08 25 Measurement and Sensor Techniques/Actuators and MT-A13-G Sensors and Measuring Systems, Basics	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of an oral exam (PL1, 20 min.), a lab course (PL2) and a project (PL3, 30 hours).	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (4PL1 + PL2 + 2PL3)/7	
Frequency	Annually, in the winter semester	

Workload	210 hours
Duration	1 semester

Module number	**Module name**	**Lecturer in charge**
MT-A14-G	Electrified Mobility (*Elektrifizierte Mobilität*)	Prof. Dr.-Ing. B. Bäker
Contents and objectives	Content: Energy management and operating strategies in mobile and stationary systems as well as diagnosis of mechatronic vehicle systems. The focus is on: 1. Electrification of the drive train and fundamentals of energy management 2. Characterization of electrical storage systems in stationary and mobile operation 3. Design of operating strategies for electrified drive trains 4. Methods of onboard and offboard diagnostics Objective: Having completed this module, the students are able to 1. develop, evaluate and optimize energy management systems and operating strategies. 2. develop diagnostic capable electrical and mechatronic vehicle systems.	
Modes of teaching and learning	3 SWS lecture, 2 SWS lab course, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 01 23 Micro Computer Engineering/Embedded Controller and MT-12 08 01 Fundamentals of Electrical Engineering	
Usability	This module is an elective module of the group "applications" within the *Diplom* programme in Mechatronics.	
Requirements for the award of ECTS credit points	The credit points are awarded if the module assessment is passed. The module assessment consists of one written exam (120 min.) on objective 1 (K1), a written exam (90 min.) on objective 2 as well as several lab sessions on objective 1 and 2.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (K1 + K2)/2	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	