TECHNISCHE UNIVERSITÄT DRESDEN

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

Faculty of Electrical and Computer Engineering

Information Package for International Visiting and Exchange Students

April 2022

FAKULTÄT ELEKTROTECHNIK UND INFORMATIONSTECHNIK

Description

The Faculty of Electrical and Computer Engineering, 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

The degree programme in Mechatronics is divided into **basic studies and main studies**.
The **basic studies** include **semester 1-4** (= first and second year of the programme);
the **main studies** include **semester 5-10** (= third until fifth year of the programme).

The programme **comes in modules**. Each module **consists of 1, 2, 3 or 4 parts, i.e. courses**.
Mostly the courses name is equivalent to the module name but sometimes it differs.

You must visit all parts/courses of one module!
Also, you have to choose minimum 70% of the modules offered by the Faculty of Electrical and Computer Engineering!

In the following catalogue you will find
- the **modules of our basic studies**, see here
- the **modules of the main studies**, see here.

Language of instruction

The study programme is held in **German**. Students who apply for this study programme should have **German language skills** of at least **B1**.

Profiles

Within the **main studies,** there are **4 profiles**:
- Vehicle Mechatronics and Electrified Mobility / Fahrzeugmechatronik und Elektromobilität
- Macromechatronics / Makromechatronik
- Mechatronics in Mechanical Engineering / Mechatronik im Maschinenbau
- Micromechatronics / Mikromechatronik

In order to avoid timetable conflicts you should choose from one profile!

Content of the following module catalogue

1. **Overview of the basic studies modules**, 1st-4th semester, Bachelor level – click here
2. **Overview of the main studies modules**, 5th-10th semester, all profiles – click here
   - Profile Vehicle Mechatronics and Electrified Mobility – click here
   - Profile Macromechatronics – click here
   - Profile Mechatronics in Mechanical Engineering – click here
   - Profile Micromechatorinics – click here
3. **Module descriptions of the basic studies modules** – click here
4. **Module descriptions of the main studies modules** – click here

FAQ

The FAQ shall answer any questions about the module catalogue.

Why is it called modules but not courses?

Each module consists of 1,2,3 or 4 parts, i.e. courses. Mostly, if it is just one part, the course name is equivalent to the module name.

In which semester are the modules offered?

Please look in the columns “winter semester” / “summer semester”.
The academic year at tuthe 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.

What level does the module have?

Please look in the columns “1st semester”, “2nd semester” etc. to find out the semester when it is held. Basic studies are from 1st-4th semester; main studies from 5th-10th semester.

Why are the 7th and 10th semester not indicated?

During the 7th our students conduct a traineeship in companies. In the 10th they write their final thesis.
That is why you see the columns for the 5th, 6th, 8th, 9th semester only.
The **8th** is in **summer semester** and the **9th in winter semester**.
Some modules take two semesters and start in the 8th semester, i.e. summer semester.

Please make sure that you visit the whole module!

How long is an “hour per week”?

An hour per week (German: SWS =Semesterwochenstunde) is one lesson of 45 minutes per week during the teaching period.
At the TU Dresden, **lessons** usually last for **90 minutes**, i.e. one double lesson
(German: Doppelstunde (DS).
1 double lesson (Doppelstunde) = 2 hours per week (Semesterwochenstunde)

What does L/T/P mean?

- L means lecture
- T means tutorial
- P means practical lab course

What does 2/2/0 or 4/4/1 mean?

The **first number** stands for the hours per week for the **lecture**.
The **second number** stands for the hours per week for the **exercise**.
The **third number** stands for the hours per week for the **practical lab course**.

Examples:
2/2/0 = 2 hours per week lectures (90 minutes lecture every week), 2 hours per week tutorial (90 minutes exercise every week), no practical lab course

4/1/1 = 4 hours per week lectures (180 minutes lecture every week), 1 hour (45 minutes) per week tutorial but mostly conducted as 90 minutes every other week, 1 hour (45 minutes) per week practical lab course but conducted as 90 minutes every other week or as block course.

What does "PL" mean"?

It is German for Prüfungsleistung which means assessment.

I have chosen a module – what to do next?

After you have chosen a module you should know which parts are included in the module, in which semester the parts take place, and if a lecture, tutorial and/or practical lab course is included. Furthermore you should search for it in the timetables.

Detailed information you can find on the websites Plan your Studies as well as
Create your timetable.

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

Overview of the
Basic studies modules 1st-4th semester (Bachelor level)

Module number, with link to description	**Module name** English German	**1st semester winter semester** L/T/P	**2nd semester summer semester** L/T/P	**3rd semester winter semester** L/T/P	**4th semester summer semester** L/T/P	**Language of instruction**	**ECTS Credits**
MT-01 04 01	Introduction to Analysis and Algebra Algebraische und analytische Grundlagen	6/4/0 PL				German	**11**
MT-01 04 02	Calculus for Functions with Several Variables Mehrdimensionale Differential- und Integralrechnung		4/4/0 PL			German	**9**
MT-13 00 01	Materials and Engineering Mechanics Werkstoffe und Technische Mechanik	2/1/0 PL	2/2/0 PL			German	**7**
MT-02 04 05	Basics of Science Naturwissenschaftliche Grundlagen	2/2/0	2/1/0 PL			German	**7**
MT-11 02 01	Computer Science Informatik	2/1/0 PL	2/0/1 2 PL			German	**6**
MT-12 05 01	Electronic Systems Design Geräteentwicklung		2/2/0 PL			German	**4**
MT-01 04 03	Complex Function Theory Funktionentheorie			2/2/0 PL		German	**4**
MT-01 04 04	Partial Differential Equations and Probability Theory Partielle Differentialgleichungen und Wahr-scheinlichkeitstheorie				2/2/0 PL	German	**4**
MT-12 08 01	Fundamentals of Electrical Engineering Grundlagen der Elektrotechnik	2/2/0 PL				German	**6**
MT-12 08 23	Electric and Magnetic Fields Elektrische und magnetische Felder		2/2/0 PL			German	**4**
MT-13 01 02	Fundamentals of Kinematics and Kinetics Grundlagen der Kinematik und Kinetik			2/2/0 PL		German	**5**

MT-13 01 04	Kinematics and Materials of Mechanics, Advanced Vertiefung Kinematik und Festigkeitslehre				3/3/0 PL	German	**7**
MT-13 12 01	Design Engineering and Manufacturing Engineering Konstruktion und Fertigungstechnik			5/2/0 2 PL	0/1/0 PL	German	**10**
MT-12 08 03	Dynamical Electrical Networks Dynamische Netzwerke			2/2/1 PL	0/0/1 PL	German	**7**
MT-12 02 21	Electronic Circuits Schaltungstechnik				2/1/0 PL	German	**4**
MT-12 09 01	Systems Theory Systemtheorie			2/1/0	2/2/0 PL	German	**7**
MT-12 01 02	Automation Engineering and Measurement Automatisierungs- und Messtechnik				3/2/0 PL	German	**5**
MT-12 04 01	Electrical Power Engineering Elektroenergietechnik			3/1/0 PL	0/0/1 PL	German	**5**

Overview of the
Main studies modules 5th-10th semester
(relevant for all specialization areas)

Module number, with link to description	**Module name** English German	**5th semester winter semester** L/T/P	**6th semester summer semester** L/T/P	**Language of instruction**	**ECTS Credits**
MT-13 01 01	Field Theory Feldtheorie		2/2/0 PL	German	**5**
MT-13 01 02	Numerical Methods/System Dynamics Numerische Methoden/Systemdynamik	4/2/0 2 PL	0/0/1 PL	German	**9**
MT-12 02 22	Power Electronics Leistungselektronik	2/1/0 PL		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	German	**9**
MT-12 01 23	Micro Computer Engineering/Embedded Controller Mikrorechentechnik/Embedded Controller	2/0/1	3/0/3 3 PL	German	**10**
MT-12 08 25	Measurement and Sensor Techniques/Actuators Mess- und Sensortechnik/Aktorik	2/1/0 PL	2/0/2 3 PL	German	**9**

Overview of the
Main studies modules 5th-10th semester
Profile: **Vehicle Mechatronics and Electrified Mobility**

Module number, with link to description	**Module name** English German	**8th semester** **summer semester** L/T/P	**9th semester** **winter semester** L/T/P	**Language of instruction**	**ECTS Credits**
Methodes Methoden					
MT-M01-G	Multi Body Systems, Basics Mehrkörpersysteme Grundlagen	3/2/0 PL		German	**7**
MT-M01-V	Multi Body Systems, Advanced Mehrkörpersysteme Vertiefung		3/3/0 2 PL	German	**7**
MT-M05-G	Electrical Drive Engineering, Basics Elektrische Antriebstechnik Grundlagen	4/2/0 2 PL		German	**7**
MT-M05-V	Electrical Drive Engineering, Advanced Elektrische Antriebstechnik Vertiefung		2/1/2 2 PL	German	**7**
MT-M08	Electric traction motors Elektrische Fahrmotoren	4/1/1 2 PL		German	**7**
Applications Anwendungen					
MT-A01-G	Automotive Vehicle Engineering, Basics Kraftfahrzeugtechnik Grundlagen	2/0/1 2 PL	2/1/0 PL	German	**7**
MT-A01-V	Automotive Vehicle Engineering, Advanced Kraftfahrzeugtechnik Vertiefung	4/0/0 2 PL	2/1/0 PL	German	**7**
MT-A02-G	Railway Vehicle Engineering, Basics Schienenfahrzeugtechnik Grundlagen	4/0/0 PL		German	**7**
MT-A02-V	Railway Vehicle Engineering, Advanced Schienenfahrzeugtechnik Vertiefung		3/1/0 PL	German	**7**

MT-A03-G	Combustion Engines, Basics Verbrennungsmotoren Grundlagen	5/1/0 2 PL		German	**7**
MT-A03-V	Combustion Engines, Advanced Verbrennungsmotoren Vertiefung		4/0/2 2 PL	German	**7**
MT-A14-G	Electrified Mobility Elektrifizierte Mobilität		3/0/2 2 PL	German	**7**
MT-A30	Fuels Cells Brennstoffzellen		4/2/0 PL	German	**7**
MT-A31	Fundamentals of Energy Storage Grundlagen der Energiespeicherung	4/2/0 PL		German	**7**
MT-A32	Hydrogen Technologies Wasserstofftechnik		4/2/0 2 PL	German	**7**
MT-A33-G	Fundamentals of Electrical Power Systems Grundlagen elektrischer Energieversorgungs-systeme		3/2/0 2 PL	German	**7**
MT-A33-V	Planning of Electrical Power Systems Planung elektrischer Energieversorgungs-systeme	4/3/0 3 PL		German	**7**

Overview of the
Main studies modules 5th-10th semester
Profile: **Macromechatronics**

Module number, with link to description	**Module name** English German	**8th semester** **summer semester** L/T/P	**9th semester** **winter semester** L/T/P	**Language of instruction**	**ECTS Credits**
Methodes Methoden					
MT-M04-G	Control, Basics Regelung und Steuerung Grundlagen	4/2/0 2 PL		German	**7**
MT-M04-V	Control, Advanced Regelung und Steuerung Vertiefung	2/0/0 PL	2/1/0 PL	German	**7**
MT-M05-G	Electrical Drive Engineering, Basics Elektrische Antriebstechnik Grundlagen	4/2/0 2 PL		German	**7**
MT-M05-V	Electrical Drive Engineering, Advanced Elektrische Antriebstechnik Vertiefung		2/1/2 2 PL	German	**7**
Applications Anwendungen					
MT-A01-G	Automotive Vehicle Engineering, Basics Kraftfahrzeugtechnik Grundlagen	2/0/1 2 PL	2/1/0 PL	German	**7**
MT-A01-V	Automotive Vehicle Engineering, Advanced Kraftfahrzeugtechnik Vertiefung	4/1/0 2 PL	2/0/0 PL	German	**7**
MT-A02-G	Railway Vehicle Engineering, Basics Schienenfahrzeugtechnik Grundlagen	4/0/0 PL		German	**7**
MT-A02-V	Railway Vehicle Engineering, Advanced Schienenfahrzeugtechnik Vertiefung		3/1/0 PL	German	**7**
MT-A04-G	Mechatronic Drive Systems, Basics Mechatronische Antriebssysteme Grundlagen		4/2/0 PL	German	**7**
MT-A04-V	Mechatronic Drive Systems, Advanced Mechatronische Antriebssysteme Vertiefung		2/1/2 2PL	German	**7**

MT-A05-G	Aerospace Engineering, Basics Luft- und Raumfahrttechnik Grundlagen	3/3/0 2 PL		German	**7**
MT-A05-V	Aerospace Engineering, Advanced Luft- und Raumfahrttechnik Vertiefung		4/1/0 2 PL	German	**7**

Overview of the
Main studies modules 5th-10th semester
Profile: **Mechatronics in Mechanical Engineering**

Module number, with link to description	**Module name** English German	**8th semester** **summer semester** L/T/P	**9th semester** **winter semester** L/T/P	**Language of instruction**	**ECTS Credits**
Methodes Methoden					
MT-M02-G	Fluid mechatronics in industrial applications Fluidmechatronik in Industrieanwendungen	2/2/1 2 PL		German	**7**
MT-M02-V	Fluid mechatronics in mobile applications Fluidmechatronik in mobilen Anwendungen		3/1/1 2 PL	German	**7**
MT-M03-G	Mechanical Construction, Basics Maschinenkonstruktion Grundlagen	2/0/1 2 PL	2/0/1 2 PL	German	**7**
MT-M03-V	Mechanical Construction, Advanced Maschinenkonstruktion Vertiefung	3/2/0 2 PL		German	**7**
Applications Anwendungen					
MT-A06-G	Mobile Production Machines, Basics Mobile Arbeitsmaschinen Grundlagen	4/2/0 2 PL		German	**7**
MT-A06-V	Mobile Production Machines, Advanced Mobile Arbeitsmaschinen Vertiefung		2/2/2 2 PL	German	**7**
MT-A07-G	Motion Controlled Machine Systems, Basics Bewegungsgeführte Maschinensysteme Grundlagen	3/2/0 PL		German	**7**
MT-A07-V	Motion Controlled Machine Systems, Advanced Bewegungsgeführte Maschinensysteme Vertiefung		2/1/2 2 PL	German	**7**
MT-A08-G	Robotics, Basics Robotik Grundlagen	5/1/0 2 PL		German	**7**

MT-A08-V	Robotics, Advanced Robotik Vertiefung		3/2/2 2 PL	German	**7**
MT-A09-G	Specific Production Methods, Basics Spezielle Fertigungsmethoden Grundlagen	3/1/1 PL		German	**7**
MT-A09-V	Specific Production Methods, Advanced Spezielle Fertigungsmethoden Vertiefung		3/1/2 3 PL	German	**7**

Overview of the
Main studies modules 5th-10th semester
Profile: **Micromechatronics**

Module number, with link to description	**Module name** English German	**8th semester** **summer semester** L/T/P	**9th semester** **winter semester** L/T/P	**Language of instruction**	**ECTS Credits**
Methodes Methoden					
MT-M06-G	Process Control Engineering, Basics Prozessinformationsverarbeitung Grundlagen	4/0/2 4 PL		German	**7**
MT-M06-V	Process Control Engineering, Advanced Prozessinformationsverarbeitung Vertiefung		2/2/2 2 PL	German	**7**
MT-M07-G	Design Techniques, Basics Entwurfstechniken Grundlagen	2/1/0 PL	2/1/0 PL	German	**7**
MT-M07-V	Design Techniques, Advanced Entwurfstechniken Vertiefung	2/1/0 PL	2/1/0 PL	German	**7**
Applications Anwendungen					
MT-A10	Simulation Methodologies in System Design Simulation in der Gerätetechnik	2/4/0 PL		German	**7**
MT-A11-G	Micro-Electro-Mechanical-Systems, Basics Mikro-Elektro-Mechanische Systeme Grund-lagen	4/2/0 2 PL		German	**7**
MT-A11-V	Micro-Electro-Mechanical-Systems, Advanced Mikro-Elektro-Mechanische Systeme Vertiefung	2/0/0 PL	2/0/2 2 PL	German	**7**
MT-A12-G	Biomedical Engineering, Basics Biomedizintechnik Grundlagen	5/1/0 PL		German	**7**
MT-A12-V	Biomedical Engineering, Advanced Biomedizintechnik Vertiefung		4/1/1 2 PL	German	**7**

MT-A13-G	Sensors and Measuring Systems, Basics Sensoren und Messsysteme Grundlagen	5/2/0 2 PL		German	**7**
MT-A13-V	Sensors and Measuring Systems, Advanced Sensoren und Messsysteme Vertiefung		3/0/0 2 SWS project 2 PL	German	**7**
MT-A15-V	Electromechanical Design Gerätekonstruktion		2/0/4 2 PL	German	**7**
MT-A15-G	Product and Precision Device Engineering Entwicklung feinwerktechnischer Produkte	4/0/2 2 PL		German	**7**

Module descriptions
Basic studies modules 1st-4th semester

Module number	Module name	Lecturer in charge
MT-01 04 01	Introduction to Analysis and Algebra	Prof. Dr. rer. nat. habil. Z. Sasvári
Contents and objectives	Contents of the module are set theory, real and complex numbers, sequences of numbers and series, analysis of real functions of a variable, linear spaces and pictures, matrices and determinants, systems of linear equations, eigenvalues and eigenvectors. Outcomes: The students have basic mathematical knowledge and knowledge of algebra. They are capable to calculate with (complex) numbers and to apply functions, sequences and series, vectors (Vector space), determinants and matrizes.	
Modes of teaching and learning	6 hours per week lectures, 4 hours per week tutorials, and self-study	
Prerequisites	Knowledge of mathematics on “Abitur” level.	
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 180 minutes.	
ECTS credit points and grades	11 ECTS credit points The module grade is the grade of the exam.	
Frequency	Annually, in the winter semester	
Workload	330 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-01 04 02	Calculus for Functions with Several Variables	Prof. Dr. rer. nat. habil. Z. Sasvári
Contents and objectives	Contents of the module is the analysis of real functions of several variables, vector analysis, function series (power and Fourier series), differential equations. Outcomes: The students have knowledge of the differentiation and integration of functions with one and more variables, for the analytical solution of differential equations and differential equation systems and for the vector analysis.	
Modes of teaching and learning	4 hours per week lectures, 4 hours per week tutorials, and self-study	
Prerequisites	Competencies acquired in modules such as MT-01 04 01 Introduction to Analysis and Algebra, or equivalent.	
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 150 minutes.	
ECTS credit points and grades	9 ECTS credit points The module grade is the grade of the exam.	
Frequency	Annually, in the summer semester	
Workload	270 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-13 00 01	Materials and Engineering Mechanics	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 hours per week lectures, 3 hours per week tutorials, 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-02 04 05	Basics of Science	Dr. Eduard Lavrov
Contents and objectives	The module covers the main areas of mechanics as well as vibrations and waves from the field of physics. In addition, students can choose either the further particular topics of physics, especially thermodynamics, optics and structure of matter or basic introductions to chemical reactions and processes, especially general and organic chemistry, chemical thermodynamics and electrochemistry, and their practical application. Outcomes: After completing the module, the students understand nature-scientific contexts and their application in the engineering practice. With the thinking and working methods of physics and chemistry they are capable of solving problems in physics and chemistry on their own.	
Modes of teaching and learning	4 hours per week lectures, 3 hours per week tutorials, and self-study	
Prerequisites	Knowledge of physics and chemistry on “Abitur” level.	
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 180 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the exam.	
Frequency	Annually, beginning in the winter semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
MT-11 02 01	Computer Science	Prof. Dr.-Ing. Diana Göhringer
Contents and objectives	The module covers the areas of construction and programming of computers. This includes information presentation, Boolean basic circuits, arithmetic units, memory and control units as well as basic concepts of simple calculators and assembler programming, object-oriented programming and alternative programming paradigms. After completing the module the students have competencies and practical skills in the evaluation and design of computer circuits and processor architecture. They are able to program computer at low abstraction level in assembler and at a high level of abstraction in an object-oriented programming language.	
Modes of teaching and learning	4 hours per week lectures, 1 hours per week tutorial, 1 hour per week practical lab course, and self-study.	
Prerequisites	Knowledge of mathematics on “Abitur” level.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of two written exams of 120 minutes each and an ungraded project work.	
ECTS credit points and grades	6 ECTS credit points If the project work is evaluated as “passed”, the module grade is the weighted mean of the two exams. If the project work is evaluated as “not passed”, the module grade is the weighted mean of the exams as follows: M = (2·PL1 + 2· PL2 + 6 ·5) / 10.	
Frequency	Annually, beginning in the winter semester	
Workload	180 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
MT-12 05 01	Electronic Systems Design	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 hours per week lectures, 2 hours per week tutorials, 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
MT-01 04 03	Complex Function Theory	Prof. Dr. rer. nat. habil. Z. Sasvári
Contents and objectives	Content of the module is the function theory with the main focus on differentiation, integration, series development and conformal transformation. Outcomes: The students have knowledge of functions with complex variables.	
Modes of teaching and learning	2 hours per week lectures, 2 hours per week tutorials, and self-study.	
Prerequisites	Competencies acquired in modules such as MT-01 04 01 Introduction to Analysis and Algebra, MT-01 04 02 Calculus for Functions with Several Variables, or equivalent.	
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 120 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the exam.	
Frequency	Annually, in the winter semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-01 04 04	Partial Differential Equations and Probability Theory	Prof. Dr. rer. nat. habil. Z. Sasvári
Contents and objectives	The content of the module focuses on partial differential equations and probability theory. Outcomes: After completion of the module, the students have knowledge of special analytical solution methods of partial differential equations and probability theory.	
Modes of teaching and learning	2 hours per week lectures, 2 hours per week tutorials, and self-study.	
Prerequisites	Competencies acquired in modules such as MT-01 04 01 Introduction to Analysis and Algebra, MT-01 04 02 Calculus for Functions with Several Variables, MT-01 04 03 Complex Function Theory, or equivalent.	
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 120 minutes.	
ECTS credit points and grades	4 ECTS credit points The module grade is the grade of the exam.	
Frequency	Annually, in the summer semester	
Workload	120 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-12 08 01	Fundamentals of Electrical Engineering	Prof. Dr. phil. nat. habil. Ronald Tetzlaff
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 hours per week lecture, 2 hours per week 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 Electrical Engineering, Information Systems Technology, 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	Electric and Magnetic Fields	Prof. Dr. phil. nat. habil. Ronald Tetzlaff
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 hours per week lectures, 2 hours per week tutorials, 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 MT-12 08 01 Fundamentals of Electrical Engineering or equivalent.	
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-13 01 02	Fundamentals of Kinematics and Kinetics	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 hours per week lectures, 2 hours per week tutorials, 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 or equivalent.	
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 12 01	Design Engineering and Manufacturing Engineering	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 hours per week lectures, 3 hours per week tutorials, 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, MT-12 05 01 Electronic Systems Design, or equivalent.	
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 04	Kinematics and Materials of Mechanics, Advanced	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 hours per week lectures, 3 hours per week tutorials, 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, MT-13 01 03 Fundamentals of Kinematics and Kinetics, or equivalent.	
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-12 08 03	Dynamical Electrical Networks	Prof. Dr. phil. nat. habil. Ronald Tetzlaff
Contents and objectives	The module contents: the analysis of linear dynamic networks. Outcomes: After completing this module, students are able to apply methods for analyzing linear dynamic circuits excited by periodic signals and to determine the transient behavior between stationary states. They are able to describe, to model and to analyze linear two-ports. They can determine transfer functions, analyze and graphically represent the network behavior for different frequencies, and determine basic filter structures. Phasor representations and Nyquist plots are mastered.	
Modes of teaching and learning	2 hours per week lectures, 2 hours per week tutorials, 2 hours per week practical lab courses, and self-study.	
Prerequisites	Knowledge acquired in modules such as MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent. The prerequisite for participation in the lab course is to pass the module exam of the module MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent.	
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 and a lab course. Both assessments must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the weighted average of the grades of both elements of assessment. The module grade consists to 2/3 of the grade of the written exam and to 1/3 of the lab course grade.	
Frequency	annually, starting in the winter semester	
Workload	240 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
MT-12 02 21	Circuit Design	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 hours per week lectures, 1 hour per week tutorials, 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, MT-12 01 02 Automation Engineering and Measurement, or equivalent.	
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 09 01	Systems Theory	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 hours per week lectures, 3 hours per week tutorials, 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, MT-12 08 23 Electric and Magnetic Fields, or equivalent.	
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-12 01 02	Automation Engineering and Measurement	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 hours per week lectures, 2 hours per week tutorials, 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 04 01	Electrical Power Engineering	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 hours per week lectures, 1 hour per week tutorials, 1 hour per week 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
MT-12 05 01	Electronic Systems Design	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 require-ments, 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 considera-tion of all relevant aspects.	
Modes of teaching and learning	2 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	none	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module examina-tion. This examination 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 descriptions
Main studies modules 5th-10th semester

Module number	Module name	Lecturer in charge
MT-13 01 01	Field Theory	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 hours per week lectures, 2 hours per week tutorials, 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, MT-12-08 23 Electrical and Magnetic Fields, or equivalent.	
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	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 hours per week lectures, 2 hours per week tutorials, 1 hour per week lab courses, 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, MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent.	
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 02 22	Power Electronics	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 hours per week lectures, 1 hour per week tutorials, 1 project, and self-study	
Prerequisites	Competences acquired in modules such as MT-12 08 01 Fundamentals of Electrical Engineering or equivalent.	
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
MT-12 13 01	Control of Continuous-Time Processes and Discrete Event Systems	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 hours per week lectures, 2 hours per week tutorials, 1 hour per week lab course, and self-study	
Prerequisites	Competences acquired in modules such as MT-12 09 01 Systems Theory, MT-12 01 02 Automation Engineering and Measurement, or equivalent.	
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, in the winter semester	
Workload	270 hours	
Duration	2 semester	

Module number	Module name	Lecturer in charge
MT-12 01 23	Micro Computer Engineering /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 hours per week lectures, 4 hours per week lab courses, 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 08 25	Measurement and Sensor Techniques/Actuators	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 hours per week lectures, 1 hour per week tutorials, 2 hours per week lab courses, 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, MT-12 01 02 Automation Engineering and Measurement, or equivalent.	
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
MT-M01-G	Multi Body Systems, Basics	Prof. Dr.-Ing. M. Beitelschmidt
Objectives	After completion of the module the students will master the methodology of movement equations of multi body systems as well as their computer-assisted implementation for simple special cases. They will be familiar with the various algorithms of multi body simulation that are applied in commercial programmes. Further, they will 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.	
Contents	The content of the module focuses on the method of multi-body system simulation 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. For complex structures elastic bodies as model elements are necessary.	
Modes of teaching and learning	3 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-01-04-02 Calculus for Functions with Several Variables, MT-01-04-03 Complex Function Theory, MT-01-04-04 Partial Differential Equations and Probability Theory, 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, or equivalent.	
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. The module assessment consists of a written exam of 120 minutes.	
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	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 hours per week lectures, 3 hours per week tutorials, 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, or equivalent.	
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 mechatronics in industrial applications	Prof. Dr.-Ing. J. Weber
Objectives	After completion of the module, the students will know the methodological basics of control and regulation technical analysis of electrohydraulic and pneumatic drive systems. They will be able to design the relevant control circuits. They will be able to design flow controls and convert them into pneumatic circuits.	
Contents	The content of the module focuses on 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 taught. 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.	
Modes of teaching and learning	2 hours per week lectures, 2 hours per week tutorials, 1 hour per week lab courses, and self-study	
Prerequisites	Competences acquired in modules such as: MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems, or equivalent.	
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 180 minutes (PL1) and a lab course of 12 hours (PL2).	
ECTS credit points and grades	7 ECTS credit points can be earned. The module grade is the weighted mean of the exam and the lab course as follows: M = (4PL1 + PL2)/5	
Frequency	annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-M02-V	Fluid mechatronics in mobile applications	Prof. Dr.-Ing. J. Weber
Objectives	After completion of the module 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.	
Contents	The content of the mocule focuses on 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.	
Modes of teaching and learning	3 hours per week lectures, 1 hour per week tutorials, 1 hour per week lab courses, and self-study	
Prerequisites	Competences acquired in modules such as: MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems, or equivalent.	
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 180 minutes (PL1) and a lab course of 12 hours (PL2).	
ECTS credit points and grades	7 ECTS credit points can be earned. The module grade is the weighted mean of the exam and the lab course as follows: M = (4PL1 + PL2)/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	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 hours per week lectures, 2 hours per week lab courses, 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, MT-13 12 01 Construction and Manufacturing Engineering, or equivalent.	
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	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 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	Knowledge and competences that can be acquired in modules such as MT-13 12 01 Construction and Manufacturing Engineering, MT-M03-G Mechanical Construction, Basics, or equivalent 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	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 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	Knowledge and competences in dynamic systems that can be acquired in modules such as MT-12 09 01 Systems Theory, MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems, or equivalent.	
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	Prof. Dr.-Ing. habil. K. Röbenack
Contents and objectives	Content: Analysis and design of optimal and/or robust and/or non-linear 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 hours per week lectures, 1 hour per week tutorials, 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, or equivalent.	
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 MT-M05-G	Electrical Drive Engineering, Basics	PD Dr.-Ing. habil Volkmar Müller
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 hours per week lectures, 2 hours per week tutorials, 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, or equivalent.	
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 MT-M05-V	Electrical Drive Engineering, Advanced	PD Dr.-Ing. habil Volkmar Müller
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 hours per week lectures, 1 hour per week tutorials, 2 hours per week lab courses, 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, MT-M05-G Electrical Drive Engineering, Basics, or equivalent.	
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-M08	Electric traction motors	Prof. Dr.-Ing. W. Hofmann
Objectives	After completion of the module, the students have the knowledge and skills in order to design and calculate electric traction motors and their system-related integration into the drive train.	
Contents	The content of the module focuses on the *Design and calculation of electric traction motors:* Definition of the most important dimensions of electric machines, winding and magnetic circuits, determination and recalculation of machine parameters, losses, efficiency, temperature increase. Use of diverse cooling concepts, optimization of components and the entire system. and *Electric vehicle and traction drive trains:* Traction: drive train and mechanics, traction motors, power electronics: mains current converter, motor converters, engine control, tension control. Road: electric and hybrid drive trains, synchronous and asychronous traction motors, power electronics: power inverter, DC/DC converters, auxiliary drives, control and regulation, accumulators and charging technology.	
Modes of teaching and learning	The module consists of 4 hours per week lectures, 1 hour per week tutorials, 1 hour per week practical lab courses, and self-study.	
Prerequisites	Students should have competences acquired in modules such as MT-12 04 01 Electrical Power Engineering or equivalent.	
Usability	The module is an elective module of the group “methods” within the main studies of the *Diplom* programme in Mecha-tronics.	
Requirements for the award of credit points	The credit points are awarded when the module assessment is passed. The module assessment consists of an oral exam as individual exam worth 40 minutes PL1 and a lab course PL2.	
Credit points and grades	7 credit points can be obtained by the module. The module grade is the weighted mean of the grades of the examinations: M = (7 PL1 + 3 PL2) / 10.	
Frequency	The module is offered every summer semester.	
Workload	The total effort is 210 hours.	

Duration	The module takes one semester.

Module number	Module name	Lecturer in charge
MT-M06-G	Process Control Engineering, Basics	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 hours per week lectures, 2 hours per week lab courses, 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	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 hours per week lectures, 2 hours per week tutorials, 2 hours per week project, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-M06-G Process Control Engineering, Basics, or equivalent.	
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	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 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-12 01 02 Automation Engineering and Measurement, MT-12 13 01 Control of Continuous-Time Processes and Discrete Event Systems, or equivalent.	
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	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 hours per week lectures, 2 hours per week tutorials, 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	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 Objectives: 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 hours per week lectures, 1 hour per week tutorials, 2 hours per week lab courses, 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, or equivalent.	
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 of 120 minutes each (PL1+PL2) and a lab course (not graded).	
ECTS credit points and grades	7 ECTS credit points can be earned. The module grade is the weighted mean of the exams as follows: M = (PL1 + PL2) / 2	
Frequency	annually, beginning in the summer semester	
Workload	210 hours	
Duration	2 semesters	

Module number	Module name	Lecturer in charge
MT-A01-V	Automotive Vehicle Engineering, Advanced	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 hours per week lectures, 1 hour per week 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, MT-A01-G Automotive Vehicle Engineering, Basics, or equivalent.	
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 of 90 minutes each (PL1 + PL2) and a written exam of 120 minutes (PL3).	
ECTS credit points and grades	7 ECTS credit points can be earned. The module grade is the weighted mean of the exams as follows: M = (PL1 + PL2 + PL3)/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	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 hours per week 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, or equivalent. 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	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 hours per week lectures, 1 hour per week tutorials, 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, or equivalent. 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	Prof. Dr.-Ing. F. Atzler
Objectives	Having successfully completed this module, the students will know the theoretical and practical basics for the calculation of internal combustion engines and entire powertrains. They will have a deeper and fundamental understanding of the operating and system behavior of combustion engines in conventional and new types of drive systems of motor vehicles. They will be able to create own calculation models based on the aquired methodological competences.	
Contents	The content of the module focuses on theoretical basics for the calculation of powertrains in general as well as specifically of combustion engines including associated components. In addition, the module deals with the combustion engine as a subsystem in conventional and new drive systems of motor vehicles and the regulations on exhaust emissions. Further, the module also focuses on the theoretical description of the dynamics of the piston machine focusing on compensatory measures, equations of motion for characterization of torsional oscillator chains and calculation methods for their natural frequencies and eigenmode.	
Modes of teaching and learning	5 hours per week lectures, 1 hour per week tutorials, and self-study	
Prerequisites	Competences acquired in modules such as MT-02 04 05 Basics of Science MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent.	
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 of 120 minutes each (K1 + K2).	
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-A03-V	Combustion Engines, Advanced	Prof. Dr.-Ing. F. Atzler
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.	
Contents	The content of the module focuses on the design and mode of operation of a combustion engine as well as physical and thermodynamic processes, pollutant generation and avoid-ance, regulation and control. Further, the module deals with the operation of test benches and measurement technology, thermodynamic and emission-related analysis of the internal combustion engine, selected subsystems or the entire vehicle. 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 the power train, communication systems as well as the construction and functioning of automated driving.	
Modes of teaching and learning	4 hours per week lectures, 2 hours per week lab courses, and self-study	
Prerequisites	Competences acquired in modules such as MT-02 04 05 Basics of Science MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent.	
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 150 minutes (K1) and an oral exam of 30 minutes (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	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 hours per week lectures, 2 hours per week tutorials, 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, MT-12 01 02 Automation Engineering and Measurement, or equivalent.	
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	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 hours per week lectures, 1 hour per week tutorials, 1 hour per week lab courses, and self-study	
Prerequisites	Competences in electric drive technology that can be acquired in modules such as MT-A04-G Motion Control, Basics, or equivalent. Competences in control engineering that can be acquired in modules such as MT-12 01 02 Automation Engineering and Measurement and Control Engineering, or equivalent.	
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	Prof. Dr. Johannes Markmiller
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 hours per week lectures, 3 hours per week tutorials, 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, or equivalent. 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	Prof. Dr. Johannes Markmiller
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 hours per week lectures, 1 hour per week tutorials, 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-A05-G Aerospace Engineering, Basics, or equivalent. 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 Production Machines, Basics	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 hours per week lectures, 2 hours per week tutorials, 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, or equivalent.	
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 = (2*K1 + PL2)/3	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A06-V	Mobile Production Machines, Advanced	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 hours per week lectures, 2 hours per week tutorials, 2 hours per week lab courses, 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, MT-A06-G Mobile Production Machines, Basics, or equivalent.	
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	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 hours per week lectures, 2 hours per week tutorials, 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	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 hours per week lectures, 1 hour per week tutorials, 2 hours per week lab courses, and self-study	
Prerequisites	Competences acquired in modules such as MT-A07-G Motion Controlled Machine Systems, Basics, or equivalent.	
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	Prof. Dr.-Ing. M. Beitelschmidt
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.	
Contents	The content of the module focuses on robot kinematics, control of serial manipulators and guidance gear for robotics.	
Modes of teaching and learning	5 hours per week lectures, 1 hour per week tutorials, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-01-04-02 Calculus for Functions with Several Variables, MT-01-04-03 Complex Function Theory, MT-01-04-04 Partial Differential Equations and Probability Theory, 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, or equivalent.	
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-V Robotics, 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 of 90 minutes (PL1) and a written exam of 150 minutes (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	Prof. Dr.-Ing. habil. U. Füssel
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 hours per week lectures, 2 hours per week tutorials, 2 hours per week lab courses, 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, MT-13 01 02 Numerical Methods/System Dynamics, MT-A08-G, Robotics, Basics, or equivalent.	
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	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 techno-logical 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 hours per week lectures, 1 hour per week tutorials, 1 hour per week lab courses, 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 Engi-neering, or equivalent.	
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	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 hours per week lectures, 1 hour per week tutorials, 2 hours per week lab courses, and self-study	
Prerequisites	Competences in science and competences that can be acquired in modules such as MT-A09-G Specific Production Methods, Basics, or equivalent.	
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
MT-A10	Simulation Methodologies in System Design	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	Content: 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 hours per week lectures, 4 hours per week tutorials, and self-study	
Prerequisites	Comptences acquired in modules such as MT-12 05 01 Electronic Systems Design, or equivalent.	
Requirements for the award of ECTS credit points	The credit points are earned when the module assessment is passed. The module 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 the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A11-G	Micro-Electro-Mechanical Systems, Basics	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 hours per week lectures, 2 hours per week tutorials, 1 hours per week 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, or equivalent.	
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	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 hours per week lectures, 2 hours per week lab courses, 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, or equivalent.	
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	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 hours per week lectures, 1 hour per week tutorials, 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, MT-12 05 01 Electronic Systems Design, or equivalent.	
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	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	4 hours per week lectures, 1 hours per week tutorials, 1 hours per week lab courses, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-A12-G Biomedical Engineering, or equivalent.	
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	Prof. Dr.-Ing. habil. J. Czarske
Objectives	1. The students will know different measuring systems for the documentation of processes, for example in the flow and manufacturing technology. They will be able to feature and analyse the physical principle and the technical design of measurement system technologies under real conditions. 2. They are capable to deescribe and judge the physical principle and the technical design of laser sensors. 3. They will know the basic approaches and methods of system design of mechatronic laser sensors.	
Contents	The content of the module focuses on optoelectronic components, optical surface metrology, optical storage technology, wave front sensors, light modulators, microscopy, interferometry and optomechatronic measuring systems.	
Modes of teaching and learning	5 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-02 04 05 Basics of Science, MT-12 09 01 Systems Theory, MT-12 01 02 Automation Engineering and Measurement MT-12 08 25 Measurement and Sensor Techniques/Actuators, or equivalent.	
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 a written exam of 90 minutes (K1) and on objective 1 and an oral exam (P2) of 40 minutes on objectives 2 and 3.	
ECTS credit points and grades	7 ECTS credit points The module grade is calculated as follows: M = (2K1 + 5P2)/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	Prof. Dr.-Ing. habil. J. Czarske
Objectives	Having successfully completed this module, the students are familiar with the principles as well as the practical implementation of sensors and measuring systems, especially for process, manufacturing, medical and fluid engineering. They 1. They 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. 2. They know the basics of adaptive optical systems for the imaging of and through fabric. They will also be familiar with the optogenetic manipulation of transgenic cells. 3. They will be 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.	
Contents	The content of the module focuses on pressure and temperature field measurement, speed measurement, particle size measurement, wall shear stress sensors, as well as modern adaptive optical systems for biophotonics.	
Modes of teaching and learning	3 hours per week lectures, 2 hours per week projects, and self-study	
Prerequisites	Competences that can be acquired in modules such as MT-02 04 05 Basics of Science, MT-12 09 01 Systems Theory, MT-12 01 02 Automation Engineering and Measurement, MT-12 08 25 Measurement and Sensor Techniques/Actuators, MT-A13-G Sensors and Measuring Systems, Basics, or equivalent.	
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) of 20 minutes and a project (PL2) of 30 hours.	
ECTS credit points and grades	7 ECTS credit points The module grade M is calculated as follows: M = (3PL1 + 2PL2)/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	Prof. Dr.-Ing. B. Bäker
Objectives	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.	
Contents	The content of the module focuses on 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	
Modes of teaching and learning	3 hours per week lectures, 2 hours per week lab courses, 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, MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent.	
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 minutes (PL1) on objective 1 and a written exam of 90 minutes on objective 2 if more than 20 students are registered. With up to 20 registered students the module assessment consists of two oral exams as individual exams PL1 and PL2 of 30 minutes each. Further, the students have to take part in 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 = (PL1 + PL2)/2	

Frequency	annually, in the winter semester
Workload	210 hours
Duration	1 semester

Module number	Module name	Lecturer in charge
MT-A30	Fuel Cells	Prof. Dr. A. Michaelis
Contents and objectives	Content: Balancing of material and energy flow in energy conversion plants (esp. fuel cell systems), definition of applied variables and terms related to energy and reaction, design of reactors with heterogeneous catalysed reactions, thermodynamic analysis of fuel cell systems, fundamentals of electromechanical energy conversion in the fuel cell, types of fuel cells and their design and function, fuel cell stack structure and function, system components and structure of the fuel cell systems, processes of synthesis gas production and gas treatment, thermal and catalytic afterburning of anode exhaust gas, characterization of the electrochemical properties of cells and stacks, efficiency of different system variants and its dependence on the applied fuel, requirements for fuel cell systems for different fields of application, life cycle and degradation of fuel cells and systems, fundamentals of electrolysis and cogeneration with chemical syntheses, (power-to-gas and power-to-liquids), storage concepts for electrical energy from renewable sources and meaning of the fuel cell technology for future power supply systems. Qualification goals: After successfully completing this module, the students will have broad basic knowledge in the field of fuel cell systems and electrolysis. The students are able to balance the quantity of substances and the energy on systems for energy conversion and energy storage, to describe the functioning of the fuel cell systems and to name the potential areas of application, to explain the components of the fuel cell system and their functioning, to calculate the efficiency of the energy conversion in the fuel cell system. They know the fundamentals in order to design reactors for fuel cell systems.	
Modes of teaching and learning	4 hours per week lectures, 2 hours per week tutorials, and self-study.	
Prerequisites	Competencies acquired in modules such as MT-02 04 05 Basics of Science, MT-13 00 01 Materials and Engineering Mechanics, MT-12 09 01 Systems Theory, Technical Thermodynamics, Thermodynamics of Processes, Fluid Mechanics and Heat Exchange or equivalent.	

Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. With more than 20 participants, it consists of a written exam worth 120 minutes. With up to 20 participants, the written test is replaced by an oral exam as an individual exam of 30 minutes. The nature of the specific exam is announced at the end of the registration period as usually known from the faculty.
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the exam.
Frequency	Annually, in the winter semester
Workload	210 hours
Duration	1 semester

Module number	Module name	Lecturer in charge
MT-A31	Fundamentals of Energy Storage	Prof. Dr.-Ing. T. Bocklisch
Contents and objectives	Contents of the module are - thermal and mechanical energy storage, - compressed air storage systems as well as - electrical and electrochemical storage systems. Qualification goals: After completing the module, the students will understand the basic properties of the different energy storage systems and know criteria for their comparative evaluation. They can select and dimension the energy storage systems for various applications (e.g. short or long-term storage). In addition to the technical assessment, they are also familiar with the economic and ecological aspects of the storage systems.	
Modes of teaching and learning	4 hours per week lectures, 2 hours per week tutorials, and self-study.	
Prerequisites	Competencies acquired in modules such as MT-12 04 01 Electrical Power Engineering and Specifics of Renewable Energy Systems or equivalent	
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 worth 180 minutes. With up to 5 participants, the written exam will be replaced by an oral exam as individual exam worth 45 minutes.	
ECTS credit points and grades	7 ECTS credit points The module grade is the grade of the exam.	
Frequency	Annually, in the summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A32	Hydrogen Technologies	Prof. Dr.-Ing. habil. A. Hurtado
Contents and objectives	This module includes basic aspects about the current available technical and technological requirements of a hydrogen-based energy industry (generation, storage, transport, application). It also includes further development trends in this area as well as the general energy conditions for a hydrogen energy industry (efficiency, costs, price structures). The module also focuses on low-temperature, process and storage technologies as well as safety-related aspects. Qualification goals: 1. The students will master the basics of hydrogen technology and know the associated components for a hydrocarbon-based energy industry. 2. The students will have the basics of low-temperature and storage technology for the energy source hydrogen.	
Modes of teaching and learning	4 hours per week lectures, 2 hours per week tutorials, and self-study.	
Prerequisites	Competencies acquired in modules such as Technical Thermodynamics, Specifics of Renewable Energy Systems and Introduction to Energy Economics and Management or equivalent.	
Requirements for the award of ECTS credit points	The credit points are awarded when the module assessment is passed. The module examination consists of a written exam K1 of 90 minutes for qualification goal 1 and a written test K2 of 90 minutes for qualification goal 2.	
ECTS credit points and grades	7 ECTS credit points The module grade results from the grades of the examinations according to: $M = 0.5 \cdot K1 + 0.5 \cdot K2$	
Frequency	Annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A33-G	Fundamentals of Electrical Power Systems	Prof. Dr.-Ing. P. Schegner
Contents and objectives	Contents: - Function, parameter estimation and modeling of all important equipment in electrical distribution networks - Simplified methods for the calculation of voltage and current distribution as well as the basic aspects of design and dimensioning of electrical systems Objectives: After successful completion of the module, students are able to create and apply models for equipment in the electrical power system. They have the skills to determine the parameters for the most important equipment from geometrical data, manufacturer's specification or with the help of measurements. The students are familiar with the basics of dimensioning of electrical equipment.	
Modes of teaching and learning	3 hours per week lectures, 2 hours per week tutorials, and self-study.	
Prerequisites	Competences acquired in modules such as MT-02 04 05 Basics of Science MT-12 08 01 Fundamentals of Electrical Engineering, or equivalent.	
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 120 minutes (PL1) and a written exam of 90 minutes (PL2).	
ECTS credit points and grades	7 ECTS credit points can be earned. The module grade results from the grades of the examinations according to: $M = 2/3 \cdot PL1 + 1/3 \cdot PL2$.	
Frequency	annually, in the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A33-V	Planning of Electrical Power Systems	Prof. Dr.-Ing. P. Schegner
Contents and objectives	Contents: - mathematical methods for calculating the stress of individual equipment within electrical power systems and - the principles of planning electro technical installations and distribution networks. Intended learning outcome: The students are able to calculate and assess holistically, steady and transient stress. They have mastered all important procedures and methods to dimension respectively select the equipment with regard to their voltage and current stresses and other criteria. The students know the basic standards for the planning.	
Modes of teaching and learning	4 hours per week lectures, 3 hours per week tutorials, and self-study	
Prerequisites	Competences acquired in modules such as MT-A33-G Fundamentals of Electrical Power Systems, or equivalent.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. The assessment consists of a written exam of 120 minutes and two written exams of 90 minutes. With up to 5 registered students the written exams can be replaced by an oral exams of 45 minutes and two oral exams of 30 minutes.	
ECTS credit points and grades	7 ECTS credit points The grade is determined by the arithmetic mean of the grades of the exams: M= (4 PL1 + 3 PL2 + 3 PL3) / 10.	
Frequency	annually, in summer semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A15-V	Electromechanical Design	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	Content: **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 hours per week lectures, 2 hours per week tutorials, and self-study	
Prerequisites	Comptences acquired in modules such as MT-12 05 01 Electronic Systems Design, MT-A15-G Product and Precision Device Engineering, or equivalent.	
Requirements for the award of ECTS credit points	The credit points are earned if the module assessment is passed. This assessment consists of 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 the winter semester	
Workload	210 hours	
Duration	1 semester	

Module number	Module name	Lecturer in charge
MT-A15-G	Product and Precision Device Engineering	Prof. Dr.-Ing. habil. J. Lienig
Contents and objectives	This module covers 1 Fundamentals of Product Engineering - Systematic solving of production tasks - Methods of product engineering - Structural engineering process - Creativity techniques for finding solutions - Fault avoidance during product development - Scope of duties for product engineers 2 Design of Precision Devices - Planning, construction and fabrication of a precision-mechancis drive mechanism - Finding of solution variants - Dimension and devise of an optimal solution - Creation of the set of drawings - Fabrication of parts and assembly of the device group - Initiation of the device group and verification of functionality Intended learning outcomes: Students completing this module are qualified to design innovative solutions of precision devices. They are capable of applying the concepts of product engineering and provide sets of drawings.	
Modes of teaching and learning	2 hours per week lectures, 4 hours per week practical lab courses, and self-study	
Prerequisites	Comptences acquired in modules such as MT-12 05 01 Electronic Systems Design, or equivalent.	
Requirements for the award of ECTS credit points	The credit points are obtained by passing the module assessment. This assessment consists of a written examination of 90 minutes and an assigment. With up to 5 registered students, the written exam can be replaced by an oral individual exam of 30 min. Both elements of assessment must be passed.	
ECTS credit points and grades	7 ECTS credit points The module grade is determined by the arithmetic mean of both elements of assessment, i.e. the examination and the assignment.	
Frequency	annually, during the summer semester	
Workload	210 hours	
Duration	1 semester	