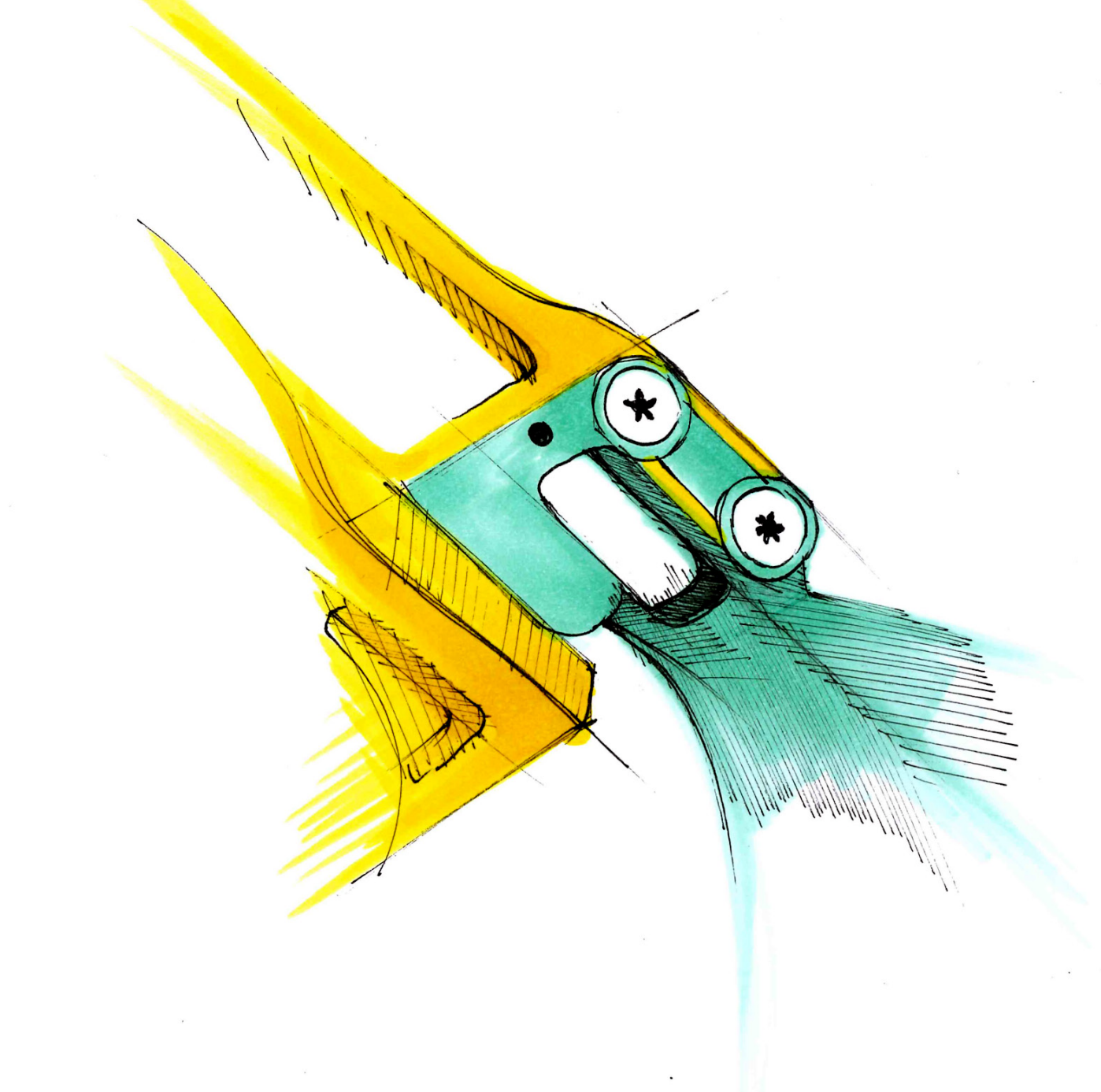
STUDIENDEKANAT
MASCHINENBAU

Leibniz
Universität
Hannover

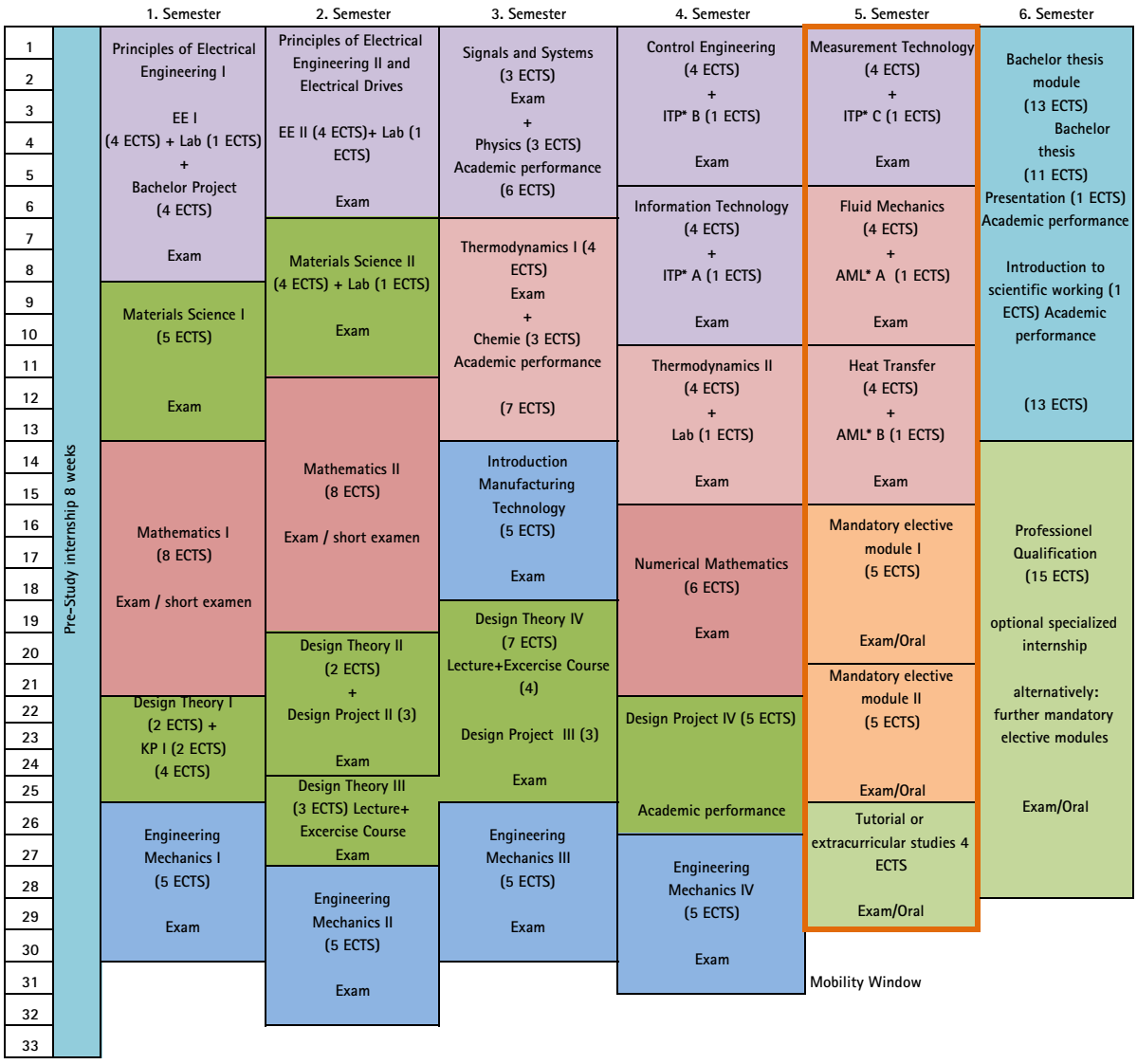
Module catalogue

Study Guide for the degree program
Mechanical Engineering
Bachelor of Science
Master of Science

Academic year 18/19



Content



ECTS	31	31	30	31	29	28	180

Mathematics and Natural Science	Electrical Engineering and Information Technology	Fundamentals of Engineering Sciences	Key Competencies	Electice field of Competencies
Design Theory & Materials Science	Bachelor Thesis	Energy Technology and Natural Sciences		

*ITP = Information Technology Internship
*AML = General Measurement Technology Lab

Module name	Electrotechnical Basic Research Laboratories I		
Module name GER	Elektrotechnisches Grundlagenlabor I		
Responsible lecturer	Dierker, Garbe, Zimmermann	Semester	WiSe
Institute	Institute of Electrical Engineering and Measurement Technology	ETCS	2

Module description

Practical implementation of theoretical and abstract electrotechnical working methods.
Basic handling of simple electrotechnical devices. Experiments with direct and alternating current:
Experiment 1: Current and voltage measurements.
Experiment 2: Network analysis.
Experiment 3: Fundamentals of electromagnetic energy conversion.
Experiment 4: Operating behavior of an asynchronous machine.

Module name	Basics of Electrical Engineering II for Mechanical Engineers		
Module name GER	Grundlagen der Elektrotechnik II		
Responsible lecturer	Hanke-Rauschenbach, Steinbrink	Semester	SoSe
Institute	Institute of Electric Power Systems	ETCS	4

Module description

This module together with the module “Fundamentals of Electrical Engineering I for Mechanical Engineering", conveys the fundamentals in the field of electrical engineering that are relevant for mechanical engineering studies. After successful completion of the module the students are familiar with:

- The important parameters for characterizing the magnetic field.
- The important types and designs of electric drive machines as well as their basic structure, their areas of application and the ability to interpret nameplate data, know the most important materials used and their application limits.
- Using the example of induction and synchronous machines, the students are able to explain the functional principle and can illustrate the operating behavior and limit characteristics of the machines by means of equivalent circuit diagrams. They also have an overview of parasitic effects (noise development, bearing load, etc.) and transient properties.
- Concepts for cooling and machine protection and have an overview of drive control in particular, speed control.
- The possible causes of electrical accidents and evaluation of the hazard potential of body currents, know the most important concepts for the avoidance of hazards caused by short circuits in the TT and TN-S systems.

Module contents:

- Magnetic field.
- Electrical machines.
- Measures to protect against electrical accidents and protective devices.

Module name	Material Science I		
Module name GER	Werkstoffkunde I		
Responsible lecturer	Maier, Nürnberger	Semester	WiSe
Institute	Institute of Materials Science	ETCS	5

Module description

Qualification goals: In this module, the basics of materials science will be taught. On the basis of the gained knowledge, students will be able to answer current questions on applications oriented to materials technologies:

- Subdivide the technical materials.
- Present the structure of solid materials.
- Material selection based on the knowledge of basic physical, chemical and mechanical properties of different metallic materials.
- State diagrams of different material systems to read and interpret.
- Explain the process of steel production and its individual steps in detail.
- Describe the influence of selected elements on the mechanical and technological properties of the material during alloy formation.
- Design a heat treatment strategy for the adjustment of desired material properties of steel materials.
- Explain different mechanical and non-destructive test methods and interpret test results.
- Explain casting processes of metallic alloys as well as basic design guidelines.
- Relate corrosion phenomena to the corresponding mechanism and find solutions to avoid or minimize corrosive attack.

Module name	Material Science II		
Module name GER	Werkstoffkunde II		
Responsible lecturer	Möhwald	Semester	SoSe
Institute	Institute of Electrical Engineering and Measurement Technology	ETCS	4

Module description

The aim of the module is to gain an understanding of the manufacturing processes, develop properties and applications of non-ferrous metals, polymer and composite materials, as well as ceramics and hard metals. After successful completion of the module, the students will be able to:

- Classify and differentiate the properties of non-ferrous metals and their alloys such as aluminium, magnesium or titanium and to describe their manufacturing processes.
- Name and explain polymer materials and their manufacturing processes.
- Present the production, properties and applications of ceramic materials in a differentiated manner.
- Classify and evaluate hard metals and cermets in terms of properties, manufacture and applications.
- Classify composite materials and explain their manufacture and application.

Contents of the module:

- Non-ferrous metals
- Polymer materials
- Ceramic materials
- Composite materials

Module name	Mathematics for Engineers I		
Module name GER	Mathematik I für Ingenieure		
Responsible lecturer	Frühbis-Krüger	Semester	WiSe
Institute	Institute of Algebraic Geometry	ETCS	8

Module description

This course conveys the basic concepts of linear algebra with applications and the solution of linear equation systems and eigenvalue problems. An introduction of the concept of limit values in its different versions and the areas based on it, such as differential and integral calculus.
Power series, series expansions, for example Taylor series, determine the course. Mathematical conclusions and methods based on them are at foreground of the subject matter.

Module name	Mathematics for Engineers II		
Module name GER	Mathematik II für Ingenieure		
Responsible lecturer	Frühbis-Krüger	Semester	SoSe
Institute	Institute of Algebraic Geometry	ETCS	8

Module description

In this course the methods of differential and integral calculus are further developed and applied to more complicated areas. This includes differential calculus applied to scalar-valued and vector-valued functions with more variables.
The integral calculus is extended to multiple integrals and line integrals. Differential equations play an important role in technical applications. The focus here is on first order differential equations and linear differential equation systems with constant coefficients.

Module name	Theory of Design I		
Module name GER	Konstruktionslehre I		
Responsible lecturer	Lachmayer	Semester	WiSe
Institute	Institute of Product Development	ETCS	2

Module description

The course teaches the basics of the design and manufacturing process of products and serves as a basis for the entire design theory.
The students will be able to :

- Name important constructive design elements of machines.
- Read and create technical drawings.
- Name methods for product development.
- Name and calculate fit types.
- Describe functionality and production of machine elements.

Module contents:

- Introduction to product development.
- Introduction to the machine elements.
- Technical drawing.
- Tolerance theory.
- Design of individual parts suitable for production.

Module name	Theory of Design II		
Module name GER	Konstruktionslehre II		
Responsible lecturer	Lachmayer	Semester	SoSe
Institute	Institute of Product Development	ETCS	2

Module description

The module conveys advanced contents from the field of design and thus deepens the learned contents of the lecture “Theory of Design I”.
The students will be able to:

- Model in parametric 3D CAD systems.
- Classify the components of the development environments of CAD systems.
- Classify gearboxes with non-uniform transmission ratios.
- Design cast and welded constructions.

Module contents:

- Methodical design and creation.
- Introduction to CAD Modeling.
- Parametric design and feature technology.
- Computer use in design-development environments.
- Drive systems.
- Gearboxes with non-uniform transmission ratios.
- Cast construction.
- Welded construction.

Module name	Theory of Design III		
Module name GER	Konstruktionslehre III		
Responsible lecturer	Poll	Semester	Wi-/SoSe
Institute	Institute of Machine Design and Tribology	ETCS	3

Module description

The module provides an overview of the essential design elements of mechanical engineering and thus takes up the contents of the lectures "Theory of design I and II". This lecture applies basic knowledge of mechanics and materials science in order to use this knowledge for the design and calculation of machine elements. After successful completion of the module, the students are able to:

- Understand complex machines in their function and the interaction of the individual machine elements.
- Design machine elements with the help of a basic understanding of common calculation methods.
- Prove their operational stability.

Contents:

- Gearwheels.
- Rolling bearings.
- Couplings.
- Springs.
- Stress–strain analysis.

Module name	Theory of Design IV		
Module name GER	Konstruktionslehre IV		
Responsible lecturer	Poll	Semester	WiSe
Institute	Institute of Machine Design and Tribology	ETCS	4

Module description

Qualification goals: The fundamentals developed in the preceding lectures as well as in mechanics and thermodynamics are applied for the design and calculation of further machine elements.
The focus is on the dynamic interaction of the components. The main focus is on gearboxes (gear, friction wheel and wrapping material), starting clutches, brakes and plain bearings. In addition, the well-known elements are dealt with in more detail, such as the theory and calculation of gear drives. Additionally, there is an introduction to further topics such as lubrication and tribology.

Contents:

- Connection types.
- Screws.
- Shaft-hub-connections.
- Plain bearings.

Module name	Constructional Project IV		
Module name GER	Konstruktives Projekt IV		
Responsible lecturer	Poll	Semester	SoSe
Institute	Institute of Machine Design and Tribology	ETCS	5

Module description

The course provides in-depth theoretical and practical knowledge of the design process of machines and equipment. The first part of the module (Product Design Project IV /Part 1) consists of a design task during the semester, in which the students design a true-to-scale assembly drawing of a gearbox.
The students are supervised during the semester by regular tutorials (certificates) in small groups.
The second part (Product Design Project IV /Part 2) consists of a written performance record in which the knowledge acquired in the "Constructional Project III" and "Constructional Project IV/Part 1" is applied. After successful participation, the students are able to:

- Draw basic technical solution on the basis of a general description of tasks.
- Convert the principle solution into a building structure and to elaborate it.
- Create assembly and production drawings of individual parts.
- Provide mathematical proofs of strength and service life of basic machine elements.
- Prepare work results.

Contents:

- Creation of requirement lists.
- Basics Calculation of gearboxes.
- Basic calculation of machine elements and connections.
- Creation of technical principle sketches.
- Preparation of technical overview drawings with consideration of necessary views and sections.
- Preparation of individual part drawings suitable for production.

Module name	Engineering Mechanics I		
Module name GER	Technische Mechanik I		
Responsible lecturer	Wallaschek, Wriggers	Semester	WiSe
Institute	Institute of Dynamics and Vibration Research	ETCS	5

Module description

Aim: The module teaches the basic methods and interconnections of statics for the description and analysis of rigid bodies. After successful completion of the module, students will be able to:

- Analyze and solve structural problems independently.
- Explain the free-body principle and the free body diagram based on it.
- Determine static equilibrium conditions of rigid bodies.
- Analytically calculate bearing reactions (incl. friction effects).
- Analyze statically determined truss.
- Determine stress values (internal forces) on the beam.

Contents:

- Statics of rigid bodies, forces and moments, equivalence of forces.
- Newtonian laws, axiom of the parallelogram of forces.
- Conditions of equilibrium, centre of gravity of rigid body.
- Adhesion and friction, Coulomb's law, rope friction and adhesion.
- Flat and spatial frameworks.
- Flat and spatial beams and frames, internal forces.
- Work, potential energy and stability, principle of virtual work.

Module name	Engineering Mechanics II		
Module name GER	Technische Mechanik II		
Responsible lecturer	Wallaschek, Wriggers	Semester	SoSe
Institute	Institute of Dynamics and Vibration Research	ETCS	5

Module description

Aim: The module imparts the basic methods and correlations of strength theory for the description and analysis of deformable solids. After successful completion of the module, students will be able to:

- Analyze and solve structural problems independently.
- Determine the loading and deformation of mechanical components as a result of different loads.
- Solve statically indeterminate problems.
- Evaluate the stability of bars under buckling load.

Contents:

- Elementary stress types, stresses and strains.
- Stresses in rope and bar, longitudinal and transverse elongation, thermal expansion.
- Solve statically indeterminate problems.
- Plane and spatial state of tension and distortion, Mohr's stress circle main stresses.
- Straight and oblique bending, moments of inertia of surfaces.
- Torsion, circular and annular cross-sections, thin-walled cross-sections.
- Energy methods in strength theory, working theorem, principle of virtual forces.
- Buckling, Euler's buckling cases.

Module name	Engineering Mechanics III		
Module name GER	Technische Mechanik III		
Responsible lecturer	Wallaschek, Wriggers	Semester	WiSe
Institute	Institute of Continuum Mechanics	ETCS	5

The basics of kinematics and kinetics are taught. The task of kinematics is to describe the position of systems in space and the changes in position as a function of time. This includes the movement of a point in space and the flat movement of rigid bodies. The connection between movements and forces are the subject matter of kinetics.
The aim is to present the basic laws of mechanics in the form of impulse and angular momentum and to apply them exemplarily to mass points and rigid bodies. Their inertia properties are also discussed. In addition, impact processes of a rigid body.

Module name	Engineering Mechanics IV		
Module name GER	Technische Mechanik IV		
Responsible lecturer	Wallaschek, Wriggers	Semester	SoSe
Institute	Institute of Continuum Mechanics	ETCS	5

Module description

An introduction to the technical vibration theory is given. Mechanical oscillators and oscillation systems that can be described by linear differential equations are treated. The aim is the representation of vibration phenomena such as resonance and damping, the determination of the time response of the oscillators as well as investigations on how this time response can be changed in the desired way.
The relation between mechanical engineering and control engineering are shown.
Free and forced oscillations with a degree of freedom (undamped and damped) as well as multiple degree of freedom systems and continua are treated.

Module name	Signals and Systems for Production and Logistics and Mechanical Engineering		
Module name GER	Signale und Systeme für Produktion und Logistik und Maschinenbau		
Responsible lecturer	Peissig	Semester	WiSe
Institute	Institute of Communications Technology	ETCS	3

Module description

The students know the basics of the time- and value-continuous theory of signals and systems and their fields of application.
They can apply the theory in the specific modules, analyze and work on the problems occurring there with systems theoretical methods.

Module name	Physics for Students of Egineering Technology		
Module name GER	Physik für Studierende der Ingenieurwissenschaften		
Responsible lecturer	Dozenten der Quantenoptik	Semester	WiSe
Institute	Institute of Quantum Optics	ETCS	3

Module description

In this course, the most important physical models from the broad spectrum of physics are explained and applied. The mathematical formulation then mostly results in an as precise and simple description of the models as possible. A sound basic knowledge of physics is an essential prerequisite for engineers to be truly innovative and not just to continuously improve what already exists.

Module name	Thermodynamics I / Chemistry		
Module name GER	Thermodynamik I / Chemie		
Responsible lecturer	Kabelac	Semester	WiSe
Institute	Institute of Thermodynamics	ETCS	7

Module description

The lecture introduces into the energetic balancing of systems and deepens this with examples from the energy technology. The students first get to know different forms of energy, balance areas and balance types in order to carry out quantitative calculations on the basis of the first law for open and closed systems. The second law introduces the concept of entropy, with which the different manifestations of energy can be evaluated. This knowledge can then be applied to technical systems such as the simple compression refrigeration system and thermal engine. In addition, the students learn simple models derived from fundamental thermodynamic equations for the rapid calculation of material properties. Module contents:

- Balance sheets and balance areas
- Condition and state variables
- Thermal, caloric and entropic equations of state for pure substances
- First and second law of thermodynamics
- Simple compression refrigeration circuit
- Thermal engine

Module name	Thermodynamics II / ThermoLab		
Module name GER	Thermodynamik II / ThermoLab		
Responsible lecturer	Kabelac	Semester	SoSe
Institute	Institute of Thermodynamics	ETCS	5

Module description

The module rounds off the fundamentals of technical thermodynamics taught in the module "Thermodynamics I/Chemistry" by applying the main laws of thermodynamics to different energy conversion processes. After successful completion of this module, students will be able to:

- Describe different paths for converting primary energy into useful energy
- Quantitatively balance and the evaluation of various technically relevant energy converters such as furnaces, fuel cells, gas turbine plants and steam power plants.
- Describe the environmental problem by burning fossil fuels and to show solutions.
- Extend the assessment of the transformability of forms of energy by the concept of exergy. The laboratory will acquire competences in the practical handling of energy converters on a laboratory scale, and social competence will be promoted through group work.

Module contents:

- Combustion and fuel cell
- Steam cycle, Stirling engine and gas turbine plant as thermal engine
- The modern power plant / CO2
- Sequestration CCS
- Flow and working processes
- Exergy and anergy
- Heat pump, chiller, air conditioning and humid air

Module name	Introduction of Manufacturing Technology		
Module name GER	Einführung in die Fertigungstechnik		
Responsible lecturer	Behrens	Semester	WiSe
Institute	Institute of Forming Technology and Machines	ETCS	5

Module description

The module provides an overview and specific knowledge of the field of machining and forming production processes. After successful completion of the module, students are able to achieve the following qualification goals:

- The economic and technical significance of production technology for industry
- Correctly classify and describe the various machining and forming manufacturing processes
- Describe the difference between machining processes with geometrically defined and undefined cutting edges on the basis of their special features and areas of application
- Describe and evaluate the economic background of machining processes on the basis of wear, service life and cost accounting
- Describe the metallurgical fundamentals for the generation of plastic deformations
- Describe the influencing variables and process limits of forming processes, to classify the mode of operation of different forming machines with regard to their areas of application

Module contents:

Fields of application of manufacturing technology, machining and non-cutting manufacturing processes, machining with geometrically defined and undefined cutting edge, calculation of process forces, chip formation, cutting materials, tool wear, tool life, quality criteria and requirements for manufacturing processes, sheet metal forming, hot massive forming, cold massive forming, forming machines, simulation in forming technology, calculation of forming grains.

Module name	Automatic Control Engineering I		
Module name GER	Regelungstechnik I		
Responsible lecturer	Reithmeier	Semester	SoSe
Institute	Institute of Measurement and Automatic Control	ETCS	4

Module description

In this course, an introduction to the basics of control engineering will be given and techniques such as root locus and Nyquist methods will be demonstrated using typical tasks.
The course is limited to linear, time-continuous systems or control loops and concentrates on their description in the frequency domain. Finally, some procedures for controller design are discussed.

Module name	Information Technology		
Module name GER	Informationstechnik		
Responsible lecturer	Stock, Overmeyer	Semester	SoSe
Institute	Institute of Transport and Automation Technology	ETCS	4

Module description

The aim of this lecture is to teach students the basics of information technology. First the mathematical basics (number systems, Boolean algebra, etc.) of information theory are explained. This is followed by the chapter software from algorithms to program. Furthermore, the structure (hardware) of EDP systems is dealt with. Through successful participation in this lecture the students are introduced to the components of modern computers and the basics of today's networks are explained.
The lecture concludes with a chapter on the security of computer systems.
Content:

- Introduction
- Overview software: number systems algorithms from algorithm to programming, programming languages, software operating systems
- Hardware: Basics HW - SW CPU ALU Register Memory Networks Auto-ID / RFID
- Security

Module name	Numerical Mathematics		
Module name GER	Numerische Mathematik		
Responsible lecturer	Attia, Leydecker	Semester	Wi-/SoSe
Institute	Institute of Applied Mathematics	ETCS	6

Different tools for engineering mathematics are learned, which are relevant for the basic studies. These tools are also used in other modules and form the basis for the knowledge and skills to be acquired in the Master's programme. After graduation, the students are qualified to:

- Translate engineering problems into mathematical structures
- Apply mathematical methods for the purpose of problem solving
- Be able to use procedures flexibly and justifiably
- Work independently on new mathematical issues
- Interpret and test the results of mathematical modeling
- Estimate the efficiency and limits of mathematical methods
- Deal creatively and constructively with mathematical methods
- Carry out subject-related research
- Understand mathematics as an abstract and strictly formalized form of language
- Understand the ideas of mathematical facts

Content:

- Direct and iterative methods for linear systems of equations
- Matrix eigenvalue problems
- Interpolation and equalization calculus, numerical quadrature
- Nonlinear equations and systems
- Laplace transform, ordinary and partial differential equations
- Boundary value tasks, eigenvalue tasks for ordinary differential equations

Module name	Metrology I		
Module name GER	Messtechnik I		
Responsible lecturer	Reithmeier	Semester	WiSe
Institute	Institute of Measurement and Automatic Control	ETCS	4

The course is an introduction to metrology. The measurement process is described and analyzed by a mathematical model. The measurement system is considered stationary and dynamic in the time and frequency domain. Measures to improve the transmission behaviour, amplification and filtering are discussed. Additionally the measured value statistics are dealt with under consideration of frequency distributions, error propagation and linear regression.

Module name	Fluid Dynamics I		
Module name GER	Strömungsmechanik I		
Responsible lecturer	Seume	Semester	WiSe
Institute	Institute of Turbomachinery and Fluid Dynamics	ETCS	4

The lecture teaches the basics of fluid mechanics. For this purpose, the flow properties of fluids are explained and the basic equations for describing the dynamics of flows are presented. First, the incompressible fluid mechanics is treated, in the context of which hydrostatics and hydrodynamics are taught.
The basic equations of fluid mechanics, such as the continuity equation and the Bernoulli equation, are derived. By applying the basic equations to technically relevant internal and external flows, students will gain an understanding of fluid mechanics in relation to technical problems. An introduction to gas dynamics will be given in view of the lectures.

Module name	Heat Transfer I		
Module name GER	Wärmeübertragung I		
Responsible lecturer	Scharf	Semester	WiSe
Institute	Institute of Power Plant Technology and Heat Transfer	ETCS	4

The module provides basic knowledge about the three mechanisms of heat transfer. After successful completion of the module, the students are able to:

- Understand the mechanisms of heat transfer based on thermodynamic laws
- Find the appropriate model for a real heat transfer technical problem and to reduce it to a sufficiently precise solution by making appropriate assumptions
- Quantitatively solve approaches to solve heat transfer problems by applying appropriate correlations
- Carry out basic thermal designs of simple heat exchangers

Contents:

- Stationary heat transfer
- Heat radiation
- Instationary heat conduction
- Heat transfer at fins
- Design of heat exchangers
- Convective heat transport
- Introduction to boiling and condensing.

Module name	Automatic Control Engineering II		
Module name GER	Regelungstechnik II		
Responsible lecturer	Reithmeier	Semester	WiSe
Institute	Institute of Measurement and Automatic Control	ETCS	5

Module description

The lecture deals with the following topics:

- Digital-to-analog and analog-to-digital converter
- Discretization of time-continuous controlled systems
- Time-discrete transmission elements (z-transformation, transmission behaviour in time and frequency domain, digital filters)
- Linear, time-invariant, digital control loops
- Stability of linear control loops
- Design method for digital controllers (dead beat design, discrete equivalent of analog controllers, root locus method, Nyquist method, state controller, etc.)
- Generation of control algorithms in the time domain and their implementation on microcomputers

Module name	Automation: Components and Equipments		
Module name GER	Automatisierung: Komponenten und Anlagen		
Responsible lecturer	Overmeyer	Semester	SoSe
Institute	Institute of Transport and Automation Technology	ETCS	5

Module description

The lecture explains the terminology of automation and provides basic knowledge for the design of components and automated systems with a focus on production engineering. After successful completion of the module, the students will be able to:

- Define basic terms of automation technology
- Sensor types can be differentiated according to their mode of operation and suitable sensors can be selected for an automation task
- Select mechanical, electrical and pneumatic actuators for an automation task
- Design mechanical actuators depending on load variables and to describe and design pneumatic systems
- Characterize system components such as fast axes and handling elements with their advantages and disadvantages
- Distinguish bus systems with regard to their application in production plants
- Describe and apply common design procedures for production systems

Contents:

- Introduction to automation technology
- Sensors: Physical sensor effects, optical sensors
- Mechanical actuators, electrical actuators and switches, pneumatic actuators
- System components: controls, fast axes, handling elements, bus systems
- Design procedures for plants
- Automated conveyor systems, system technology in the semiconductor industry

Module name	Basic Transport Phenomena		
Module name GER	Transportprozesse in der Verfahrenstechnik I		
Responsible lecturer	Glasmacher	Semester	WiSe
Institute	Institute of Multiphase Processes	ETCS	5

Module description

Qualification goals:
The module imparts solution competencies for coping with specific tasks in process engineering. The focus is on convective and diffusive mass transport processes as well as rheological laws in single-phase applications and their technical implementation.
After successful completion, the students will be able to:

- Explain and analyze transport processes and to explain processes that are elementary and mathematically easier to handle by applying simplistic considerations
- Explain the basics of dimensioning of apparatuses and plants for material changing processes
- Carry out a basic technical design based on the process parameters

Contents:

- Diffusion in dormant media
- Chemical reactions
- Compensation processes
- Flows in pipes and on flat plates
- Drying of solid materials
- Single-phase flows in packed layers
- Filtration

Module name	Biocompatible Materials		
Module name GER	Biokompatible Werkstoffe		
Responsible lecturer	Klose	Semester	SoSe
Institute	Institute of Materials Science	ETCS	5

Module description

Qualification goals: The lecture Biocompatible Materials gives a basic overview of the implants and implant materials currently used in medicine. After successful participation in the course, the students will be able to:

- Explain the basics of materials science and their interactions with other implanted materials
- The influence of metallic implants on the tissue is described by cases of damage to endoprostheses
- Detailed contents, especially with regard to the material classes metals, polymers and ceramics and their manufacturing and application-specific characteristics, whereby both absorbable and permanent implant applications are considered, named, characterized and evaluated

Module name	Biomedical Engineering for Engineers I		
Module name GER	Biomedizinische Technik für Ingenieure I		
Responsible lecturer	Glasmacher	Semester	WiSe
Institute	Institute of Multiphase Processes	ETCS	5

Module description

Qualification goals: The module teaches the basics of biomedical technology using a number of methods and medical devices. After successful completion of the module, students are able to:

- Explain the anatomical and physiological basics of relevant tissues and organs.
- Explain the basic exchange and transport processes of substances in the body and their basic principles.
- Describe mathematical ones.
- Explain the function of medical devices and implants and to abstract and mathematically describe the basic processes.

Contents:

- Anatomy and Physiology.
- Biological interaction and biocompatibility.
- Blood currents.
- Medical devices and applications.
- Implant technology and endoprosthetics.

Module name	CAx-Applications in Production		
Module name GER	CAx-Anwendungen in der Produktion		
Responsible lecturer	Böß	Semester	WiSe
Institute	Institute of Production Engineering and Machine Tools	ETCS	5

Module description

The event provides an introduction to the functionality and fields of application of computer-aided systems (CAx) for the planning of machining manufacturing processes. The topics will lead along the CAD-CAM process chain (Computer Aided Design/Manufacturing). After successful completion of the module, the students will be able to:

- Plan the superordinate process flow for the execution of machining processes
- Evaluate and select different procedures
- Apply basic procedures for the representation and transformation of geometric objects in CAx systems
- Write simple programs for numerically controlled machine tools
- Explain the models for the representation of workpieces in the simulation of manufacturing processes
- Explain the steps to be taken in work preparation

The following contents are covered:

- Mathematical methods and models for the representation of geometric objects
- Structure, types and functionality of software tools for production planning
- Programming languages for numerically controlled machine tools. Functionality of
- Machine controls
- Planning of manufacturing processes on numerically controlled
- Machine tools
- Method for the simulation of machining manufacturing processes
- CAx in current research topics
- Structuring and classification of work preparation

Module name	Concurrent Engineering		
Module name GER	Concurrent Engineering		
Responsible lecturer	Mr. Wurz	Semester	WiSe
Institute	Institute of Micro Production Technology	ETCS	5
Module description			

The competitiveness of a company is largely determined by the speed at which new, customer-oriented products are brought to market (time-to-market). The aim of the lecture is to impart knowledge for shortening this time to market, which is achieved by networking product and process development. Different approaches, concepts and methods of product, technology and team management are considered. Furthermore, examples of the use of concurrent engineering in industry will be shown. The students will learn how to Concurrent Engineering process.

Module name	Continuum Mechanics I		
Module name GER	Continuum Mechanics I		
Responsible lecturer	Aldakheel	Semester	WiSe
Institute	Institute of Continuum Mechanics	ETCS	5

Module description

Description of the module: In “Continuum Mechanics I” basic tensor algebra and tensor analysis will be discussed. Based on that, concepts of kinematics, e.g. deformation, deformation gradient, strain tensor and polar decomposition will be introduced to account for 3D continuum. Finally the balance equations (mass balance, linear and angular momentum balance, 1st and 2nd law of thermodynamics) will be illustrated.

Intended skills: For new technical development, understanding of the basic concepts of mechanics is essential to design a new product or process in an optimal way. Therefore, realistic modeling is needed. This subject handles the theoretical basics to estimate the real processes. It formulates along with the module "Finite Elements I-II" the basis for computational engineering.

The course contents:

- Introduction
- Tensor calculus
- Kinematics and stresses in 3D setting
- Curvilinear coordinate system
- Balance equations

Module name	Design for additive manufacturing		
Module name GER	Konstruktion für Additive Fertigung		
Responsible lecturer	Lachmayer	Semester	WiSe
Institute	Institute of Product Development	ETCS	5

Module description

The subject imparts knowledge in the handling of additive manufacturing processes and focuses on component design in compliance with restrictions. The fundamentals of design theory are applied to additive manufacturing in combination with the development methodology and deepened on the basis of a design task. The students:

- Know the areas of application and present process-specific characteristics
- Know the gesture restrictions and freedoms and perform calculations for component dimensioning
- Calculate business cases for a technically sensible and economical use
- Design a product design that complies with restrictions and manufacture this independently
- Think about the advantages and disadvantages on the basis of the individual product design

Module contents:

- Introduction and motivation
- Procedure arrangement
- Filament- and liquid-based processes
- Powder bed based processes
- Design methods and tools
- Material properties and quality aspects
- Business case, future scenarios
- Reverse Engineering

Module name	Energy Storage I		
Module name GER	Energiespeicher I		
Responsible lecturer	Hanke-Rauschenbach	Semester	WiSe
Institute	Institute of Electric Power Systems	ETCS	5

Module description

The module imparts knowledge on the selection and use of electrical energy storage devices. After successful completion of the module the students:

- Have an overview of different Fields of application of electrical energy storage devices and their associated business models.
- Are familiar with all important parameters for the characterization of storage and storage applications and can calculate them
- Are familiar with important storage technologies, can explain their functional principles and are familiar with their properties and typical applications
- Are familiar with a simplified simulation model for describing the operating behavior of storage devices (unified energy model) and can successfully use it to calculate storage applications (using MS Excel)
- Are familiar with the basic concepts for managing storage facilities and are able to formulate minimum strategies for selected applications
- Have an overview of the approaches to technology selection and rough dimensioning

Module contents:

- Fields of application of electrical energy storage devices
- Important terms and parameters
- Technologies for storing electrical energy
- Simplified description of the operating behaviour of electrical energy storage devices
- Operational management of electrical energy storage devices
- Selection of technology and rough dimensioning

Module name	Finite Elements I		
Module name GER	Finite Elements I		
Responsible lecturer	Marino, Soleimani	Semester	WiSe
Institute	Institute of Continuum Mechanics	ETCS	5

Module description

During the last decades the Finite Element Method has become the most important industrial simulation tool because it is applicable to a huge amount of industrial problems. In "Finite Elements I" the basics of the Finite Element Method applied to linear elasticity are taught. First, simple mechanical models like rods and beams that are well known from engineering mechanics are treated. By means of simple two dimensional continuum mechanics problems the isoparametric concept, numerical quadrature, the calculation of equivalent nodal forces as well as post-processing, error estimation and control and visualization of results are discussed. Finally numerical methods for dynamic problems such as time integration schemes and modal analysis are presented.

Module name	Fluid flow engines		
Module name GER	Fluidenergiemaschinen		
Responsible lecturer	Seume	Semester	WiSe
Institute	Institute of Turbomachines and Fluid Dynamics	ETCS	5
Module description			

The aim of this lecture is to develop a qualitative intuition for engineering problems and challenges of fluid energy engines, especially turbomachinery, based on the fundamental fundamentals of this discipline. These fundamentals will be complemented by a number of practical case studies to which the methods developed in the lecture will be applied. In this way, their performance and limits are demonstrated. The students are sensitized to the multitude of considerations and influences which determine the design of these complex machines and thus prepare them for the next step, the design (lecture Aerothermodynamics of Turbomachinery).

Module name	Industrial Handling and Assembly		
Module name GER	Handhabungs- und Montagetechnik		
Responsible lecturer	Raatz	Semester	WiSe
Institute	Institute of Assembly Technology	ETCS	5

Module description

The module gives a complete overview of the theoretical basics of assembly technology. Methods for the design of assembly systems are dealt with and examples from industry for the implementation of joining and handling processes are presented. After successful completion of the module, the students will be able to:

- Derive an industrial assembly concept from a product analysis
- Plan assembly processes and to evaluate their automatability as well as
- Evaluate the economic efficiency of assembly processes

Module contents:

- Assembly planning according to REFA and other methods
- Assembly-oriented product design and the interactions between plant structure and product structure
- Joining and handling
- Automation of assembly processes (manual, hybrid, automated workstations; feeding technology; industrial robots; gripping technology)
- Evaluation of the assembly with regard to economic criteria

Module name	Internal Combustion Engines I		
Module name GER	Verbrennungsmotoren I		
Responsible lecturer	Dinkelacker	Semester	WiSe
Institute	Institute for Technical Combustion	ETCS	5

Module description

The module teaches the basics of the structure, function and calculation of the combustion engine.
After successful completion of the module, the students will be able to:

- Explain in detail how gasoline and diesel engines work
- Calculate an engine thermodynamically and mechanically
- Explain gasoline and diesel engine combustion processes in order to characterize them in detail

Contents:

- Social integration of combustion engines
- Design structure
- Circular processes
- Fundamentals of combustion
- Gasoline and diesel engines
- Engine maps
- Pollutants
- Exhaust gas treatment
- Alternative drive concepts

Module name	Knowledge-Based CAD		
Module name GER	Wissensbasiertes CAD		
Responsible lecturer	Lachmayer, Gembarski	Semester	SoSe
Institute	Institute of Product Development	ETCS	5

Module description

Building on the courses on design theory and computer-aided design, the course teaches knowledge-based CAD techniques and tools for automating design tasks and product configuration. It is aimed at advanced Bachelor students who would like to get to know the full range of functions of modern CAD tools and would like to work in a more project-oriented way. The students:

- Learn the tools to implement design knowledge into CAD models
- Create models of individual parts and assemblies in Autodesk Inventor that adapt themselves to changing requirements
- Work in teams to automate design tasks
- Train project-oriented work and learn the personal skills to successfully complete a Flipped Classroom event

Module contents:

- Course concept, self-organization in Flipped Classroom
- Types of knowledge and knowledge modelling
- Coding of specialist knowledge in knowledge-based systems and in CAD
- Process models for the development of knowledge-based systems
- Coding of control knowledge in knowledge-based systems and in CAD
- Knowledge-based design systems in development environments
- Solution space management by means of knowledge-based CAD
- Generative design

Module name	Machine Tools I		
Module name GER	Werkzeugmaschinen I		
Responsible lecturer	Denkena	Semester	WiSe
Institute	Institute of Production Engineering and Machine Tools	ETCS	5

Module description

Qualification goals: The module imparts basic knowledge about the structure and functionality of machine tools as well as application-oriented methods for technical and economic evaluation. After successful completion of the module, students can:

- Differentiate machine tools according to their design and degree of automation and classify them in the technical and economic environment
- Assign function carriers or assemblies to the different functions of a machine tool
- Evaluate the economic efficiency of machine tools with investment and cost accounting methods
- Evaluate the technical properties of machine tools using analytical calculations and suitable replacement models
- Represent the hardware structure for the numerical control of machine tools
- interpret simple programs for numerical machine controls

Content:

- Racks
- Dynamic behaviour
- Linear guides
- Feed drives
- Measuring systems
- Controls
- Hydraulic system

Module name	Management of Industrial Enterprises		
Module name GER	Betriebsführung		
Responsible lecturer	Nyhuis, Hübner	Semester	SoSe
Institute	Institute of Production Systems and Logistics	ETCS	5

Module description

Operational management refers to the management of processes in production companies. From an engineering point of view, the lecture "Management" teaches students the basics based on the process chain (planning, procurement, production, distribution). The contents are taught in lectures, demonstrated with typical examples and exercises and deepened in practical guest lectures. In addition to a general introduction to operational management, the course includes the basics of product, work and production structure planning, production planning and control, supply chain management, procurement and distribution.

Module name	Mechatronic Systems		
Module name GER	Mechatronische Systeme		
Responsible lecturer	Ortmaier	Semester	WiSe
Institute	Institute of Mechatronic Systems	ETCS	5

Module description

Qualification goals: The module provides a basic, generally valid understanding of the analysis and handling of mechatronic systems. After successful completion of the module, the students are able:

- Explain the structure of mechatronic systems and the working principles of the actuators, sensors and process computers used in mechatronic systems
- Describe and analyse the dynamic behaviour of mechatronic systems in the time and frequency domain
- Investigate and evaluate the stability of dynamic systems
- Explain model-based methods for the sensorless determination of dynamic quantities and to design an observer-supported state control based on them
- Implement and to apply the mediated procedures and methods with practice-relevant examples

Contents:

- Introduction to the basic concepts of mechatronic systems
- Actuators: Active principles of electromagnetic actuators, electric servo drive, micro-actuators
- Sensors: Functionality, classification, characteristics, degree of integration, sensor principles
- Bus systems and data processing, microcomputers, interfaces
- Basics of modeling, Laplace and Fourier transform, discretization and Z-transformation
- Fundamentals of control: stability of dynamic systems, standard controllers
- Observer-supported state control, structure criteria, Kalman filter

Module name	Metal Forming - Forming Machines		
Module name GER	Umformtechnik - Maschinen		
Responsible lecturer	Behrens	Semester	SoSe
Institute	Institute of Forming Technology and Machines	ETCS	5

Module description

In this module, students learn about the special challenges facing machine technology in the field of forming technology.

Qualification goals:

The students learn about different types of drives for presses and peripheral equipment, racks and guideways. They can explain auxiliary units such as slide weight compensation, various overload protections and mass compensation.

Students will be able to assign processes to machines based on their power and energy requirements. For the production conditions resulting from the tool concept, the students can demonstrate and design a suitable material transport into the machine or between the forming stages. They will be able to penetrate the properties of forming machines experimentally and theoretically.

Content:

They will learn about the action processes, construction and drive types, application areas and boundary conditions when using machines and ancillary equipment for the non-cutting production of metal parts on the basis of semi-finished sheet metal products (sheet metal forming), but also from solid blanks (solid forming). In addition to the allocation of processes to machines on the basis of the demand for force and forming work, the topics of drive technology, frame and guide designs, inertial forces, overload protection, part transport, feeds as well as static and dynamic properties of presses are covered.

Module name	Metrology II		
Module name GER	Messtechnik II		
Responsible lecturer	Kästner	Semester	WiSe
Institute	Institute of Measurement and Automatic Control	ETCS	5

Module description

The core of the lecture is the acquisition and discretization of measured variables in technical systems and their processing in digital computers. First, the basics of discretization and quantification of analog measurement signals will be discussed. Based on the Fourier transformation of continuous and discrete signals, the sampling theorem according to Shannon and the concept of aliasing will be discussed.
A further focus is on methods for the digital filtering of signal sequences and the application of window techniques. Finally, different methods for the correlation of measurement signals and for the estimation of power density spectra are discussed.

Module name	Multibody Systems		
Module name GER	Mehrkörpersysteme		
Responsible lecturer	Panning-von Scheidt	Semester	WiSe
Institute	Institute of Dynamics and Vibration Research	ETCS	5

Module description

Qualification goals: The module imparts knowledge on kinematic and kinetic relationships of spatial multibody systems as well as on the derivation of equations of motion. After successful completion of the module, the students are able:

- Analyze the kinematics of plane and spatial systems
- Determine correlations between position, velocity and acceleration values
- Forced conditions (holonome and non-holonome) to formulate
- Perform coordinate transformations
- Derive equations of motion with the help of impulse and momentum theorem as well as Lagrangian equations 1
- Formalisms for multi-body systems

Contents:

- Vectors, tensors, matrices
- Coordinate systems, coordinates, transformations, rotation matrices
- Constraints (rheonomic, scleronomic, holonomic, non-holonomic)
- Position, velocity and acceleration variables
- Euler's differentiation rule
- Plane and spatial movement
- Kinematics of FMD Kinetic energy
- Inertial characteristics of rigid bodies
- Center of gravity and twist theorem
- Differential and integral principles: Principle of vitrual work, principle of d'Alembert, Jourdain, Gauss, Hamilton
- Calculus of Variations
- Newton-Euler equations for multibody systems
- Lagrangian equations 1 and 2 kind
- Equations of motion for multi-body systems, linearization, gyro effect, stability

Module name	Nonlinear Vibrations		
Module name GER	Nichtlineare Schwingungen		
Responsible lecturer	Panning-von Scheidt	Semester	SoSe
Institute	Institute of Dynamics and Vibration Research	ETCS	5

Module description

The module conveys knowledge about nonlinear oscillations, their causes and peculiarities, about their mathematical description as well as about solution methods for nonlinear differential equations.
After successful completion of the module, the students will be able to:

- Explain causes and physical correlations for nonlinear effects
- Classify oscillations
- Formulate basic equations for free, self-excited, parameter excited and externally excited nonlinear systems
- Apply different methods for the approximate solution of nonlinear differential equations
- Interpret approximate solutions

Contents:

- Overview of nonlinear oscillations: Phenomena and classification
- Free, self-excited, parameter excited and externally excited nonlinear oscillations
- Method of small oscillations
- Harmonic balance
- Method of slowly changing amplitude and phase
- Fault calculation
- Chaotic movements

Module name	Power Train Technology		
Module name GER	Fahrzeugantriebstechnik		
Responsible lecturer	Dinkelacker, Poll	Semester	SoSe
Institute	Institute of Machine Design and Tribology	ETCS	5

Module description

Qualification goals: The lecture is complementary to the lecture "Grundlagen der Vehicle technology" means basic knowledge of the drive trains of land vehicles. Drive trains in the automotive, construction machinery and rail vehicle sectors are covered. After successful completion of the lecture, the students are able:

- Explain the function and constructive implementation of combustion and electric motor drives in more detail
- Identify and describe the individual components of different drive trains from the engine to the wheel
- Sketch the functionality of different clutch designs in the drive train of land vehicles and to illustrate their functionality
- Correctly classify topology variants, designs and constructive implementation of different transmission concepts
- Explain in detail the function of different designs of shift actuators and shift elements in the transmission
- Name tasks of the various components from different drive trains and to identify their mode of operation

Contents:

- Internal combustion engines
- Electric motors
- Basics
- Powertrain
- Clutches
- Vehicle transmissions
- Synchronizers and bearings
- Continuously variable transmissions (CVT)
- Hydrostatic drives
- Hydrodynamic converter components of the driveline
- Hybrid drives

Module name	Quality Management		
Module name GER	Qualitätsmanagement		
Responsible lecturer	Denkena, Keunecke	Semester	SoSe
Institute	Institute of Production Engineering and Machine Tools	ETCS	5

Module description

The module conveys the basics and ideas of modern quality management as well as the application of quality tools and methods for all phases of product management.
After successful completion of the module, the students will be able to:

- Explain and differentiate the different definitions of philosophies of quality management
- Apply the tools and methods of quality management in a situational and target-oriented way
- Anticipate challenges resulting from the interaction of different disciplines in the application of complex quality tools and methods
- Develop basic concepts for quality management systems and to evaluate them on the basis of the underlying standards
- Estimate the effects of inadequate quality in production plants
- Classify the influence of aspects such as time, costs and law

The following contents are dealt with:

- History of quality management
- Statistical basis for quality management
- Tools (Q7, K7, M7) and methods (e.g. QFD, FMEA, SPC, DoE) of quality management
- QM systems according to DIN EN ISO 9000ff
- Total Quality Management (TQM) - Quality and Law

Module name	Refrigeration cycles and heat pumps		
Module name GER	Kälteanlagen und Wärmepumpen		
Responsible lecturer	Kabelac	Semester	WiSe
Institute	Institute for Thermodynamics	ETCS	5

Module description

The module imparts knowledge of cyclic processes for continuous refrigeration and heat transformation. Starting from thermodynamic basics, different processes for refrigeration are presented and explained in detail.

After successful completion of the module, the students will be able to:

- the structure and the function of different machines for the refrigeration generation
- Describe the cycle processes of the refrigeration machines presented
- to reflect the system components of the chillers and their interaction
- to classify the environmental relevance of different refrigerants

Module contents:

- Processes for refrigeration, cyclic processes
- Vapour compression and absorption chiller
- Refrigerants and oils
- Compressors and evaporators
- Heat pumps
- Cryogenic technology

Module name	Transport Technology		
Module name GER	Transporttechnik		
Responsible lecturer	Overmeyer, Stock	Semester	WiSe
Institute	Institute of Transport and Automation Technology	ETCS	5

Module description

During this lecture the students were introduced to the basic transport systems.
Participants of this lecture learned how cranes, continuous conveyors, industrial trucks and commercial vehicles (trucks, construction machines, trains, ships, airplanes) work. In the area of inclined conveyors, the properties of the conveyor belts were intensively presented to the students. They also learned about large-scale technical solution concepts using examples from the mining industry.

Content:

- Hoists and cranes.
- Continuous conveyors.
- Conveyor belts.
- Industrial conveyors Forklift trucks, tractors, trucks.
- Road vehicles: excavators, trucks, rail vehicles, maritime, aeronautical, aerospace.

Application: Mining

Module name	Vehicle Service: Vehicle Diagnostics Technology		
Module name GER	Fahrzeugservice: Fahrzeugdiagnosetechnik		
Responsible lecturer	Becker	Semester	SoSe
Institute	Institute of Vocational Sciences in Metals Technology	ETCS	5

Module description

Qualification goals: Students can identify, select and structure diagnostic procedures for different diagnostic problems. They are able to describe diagnostic processes and define monitoring tasks in the vehicle (OBD). They use diagnostic systems and can trace diagnostic procedures back to the underlying technical procedures. You are familiar with expert system strategies for off-board diagnostics and are in a position to define appropriate to develop problem-solving strategies.

Contents:

- Vehicle diagnosis as an occupational field of activity in vehicle technology occupations
- Diagnostics and troubleshooting
- Diagnostic processes and procedures
- On-off board diagnosis
- OBD and monitoring functions
- Influence of legislation, standards and protocols on diagnostics
- The role of measurement technology in diagnostics
- Expert systems for diagnostics
- Formalized diagnostic procedures and problem-solving strategies
- Techniques for routine diagnostics, Integrated diagnostics, rule-based diagnostics and experience-based diagnostics
- Diagnostics on networked systems
- Use of diagnostic systems on the vehicle