| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **M01** | **Mathematics and Computer Science** | The students have a basic knowledge of mathematics and a script-based programming language. They are able to analyse typical mathematical and engineering problems and solve them with the help of mathematical methods and create or formulate a solution by means of a programming language. The Students can think logically and analytically. They have the ability to expand the existing knowledge in their own accord. | | | | | | **11** | Prof. Dr. K. Thiele |
| M01.1 | Mathematics I | Set theory, equations, inequations, functions, trigonometry complex numbers, vector calculus, differential calculus, integral-calculus. | 1 u. 1 | V | 6 | 4,5 | KP (K90 +LEK) | 7 | Prof. Dr. K. Thiele<br>Prof. Dr. M. Strube<br>Dr D. Balan |
| M01.2 | Computer Science | Working with a PC-based higher programming language, handling of data structures, control structures, multidimensional fields files, logical links, development methods sorting algorithms, modularisation of algorithms. | 1 u. 1 | V | 2 | 1 | K60 | 2 | Prof. Dr. U. Triltsch<br>Prof. Dr. M. Strube |
| M01.3 | Laboratory for Computer Science | Working with a PC-based higher programming language, use of control structures, multidimensional fields, text files and modularisation. | 2 u. 3 | L | 1 | 2 | PA | 2 | Prof. Dr. U. Triltsch<br>Prof. Dr. M. Strube |
| **M02** | **Physics and higher Mathematics** | Getting to know mathematical and scientific basics. Skills in physical-technical questions with the help of physics and mathematics,as to formulate and find solutions as well as assessing them. Development of a structured and logical way of thinking, the ability to abstract and accurate working methods. | | | | | | **12** | Prof. Dr. I. Ahmed |
| M02.1 | Experimental Physics | Basic concepts of mechanics (kinematics, dynamics, work and energy). Vibrations (undamped, damped, forced). Basics of the Wave theory (place-time function of mechanical waves, transversal and longitudinal waves, interference of waves, sound waves, standing waves). Fundamentals of optics: reflection, refraction, total reflection-on. Images by concave and convex mirrors and thin line-shaped lenses. Optical devices. Fundamentals of atomic and nuclear physics and of quantum mechanics. Applications in mechanical engineering. | 1 u. 1 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. I. Ahmed |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type. | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| M02.2 | Laboratory for experi mental physics | Experiments: Kinematics: Determination of the gravitational acceleration using the Atwood machine. Kinematics: Determination of the gravitational acceleration using objects in free fall. oscillations: Determination of the gravitational acceleration using a pendulum. oscillations: Determination of the gravitational acceleration with a Kater's pendulum. Modern physics: Photoelectric effect and Planck constant. Modern physics: determination of Planck constant with light emitting diodes. Oscillations: Forced oscillations with a torsion pendulum. wave theory: Determination of the propagation velocity of standing trans- versal and longitudinal waves. Optics: Lens equations and refraction. In addition, protocols are written for each experiment, including error calculations, as far as they are applicable. | 2 u. 3 | L | 1 | 2 | PA | 2 | Prof. Dr. I. Ahmed |
| M02.3 | Mathematics II | Differential equations: Setting up and solving ordinary first and second order differential equations with according applications. Laplace transformations. Fourier transformations. Further functions with a single independent variable with according applications (parameter shape, polar co-ordinates). Functions with several independent variables: Basics, presentation, partial derivatives, the total differential, relative maxima and minima with and without additional conditions. Multiple integration. Basic linear algebra with applications. Vector calculus. | 2 u. 3 | V | 6 | 7 | KP (K90 +LEK) | 7 | Prof. Dr. I. Ahmed |
| **M03** | **Applied Physics** | Profound technical knowledge in mathematical, scientific and engineering fundamentals Problem-solving skills: Skills for analysis and structuring of technical problems. | | | | | | **6** | Prof. Dr. F. Klinge |
| M03.1 | Thermodynamics | Contents: state functions, work and internal energy, equations of state, enthalpy, laws of thermodynamics, heat capacity, changes of state, entropy, thermodynamic cycles. learning objectives: The lecture is an important basis for many areas of mechanical engineering (compressed gases, heat flows). The students are to develop an understanding of how the tasks of engineering fit into the different chapters of thermodynamics to be able to classify them. Furthermore, typical applications of the content mentioned above can be adequately analysed and evaluated. | 4 u. 6 | V | 3 | 1,5 | K90 | 3 | Prof. Dr. C. Heikel |
| M03.2 | Fluid mechanics | Friction, viscosity, resistance and characteristic curves of piping systems, conservation of momentum, buoyancy and resistance of curved surfaces, Basics of modern flow calculation (CFD) and modern optical flow measurement technology, supersonic flows. | 4 u. 6 | V | 3 | 1,5 | KP (K60 +PA) | 3 | Prof. Dr. F. Klinge |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **M04** | **Electrical Engineering** | The students possess the competence to analyse and calculate circuits in a structured way with the help of the acquired sound technical knowledge of electrical engineering problems and circuits. | | | | | | **10** | Prof. Dr. C. Hartwig |
| M04.1 | Electrical Engineering Basics | Basic terms: charge, current, voltage and electrical power; Calculation of direct current networks; electrostatic field and Capacity; Stationary electric flow field; Magnetic field: Magnetomotive force, force effects, laws of electromagnetic induction, inductance and inductive coupling; linear alternating current networks with harmonic current sources: phasor calculation, electrical power. | 2 u. 3 | V | 4 | 3,5 | K90 | 5 | Prof. Dr. C. Hartwig<br>Dipl.-Ing. B. Zemmiri |
| M04.2 | Laboratory for electrical engineering | Tests are to be carried out on the following topics: electrical engineering Measurement equipment, electrical and electronic components, measuring of current, voltage and power. | 3 u. 4 | L | 1 | 2 | PA | 2 | Dipl.-Ing. B. Zemmiri |
| M04.3 | Electrical engineering and Electronics | Symmetrical three-phase system: wye and delta connection, power in the three-phase electric system. Transient processes in networks: Linear networks with capacitors or inductors, switching processes. Basics of Semiconductor technology: intrinsic and impurity conduction, pn-junction, diode, bipolar transistor. Basics of digital technology: gates, flip-flops. | 3 u. 4 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. C. Hartwig |
| **M05** | **Basics of Me-chanics** | In this module, students acquire profound knowledge in the field of engineering fundamentals. The skills for modelling, analysis of technical problems, implementing strategies for their solution and for the confident application of appropriate methods. | | | | | | **11** | Prof. Dr. T. Streilein |
| M05.1 | Statics | Plane and spatial statics: basic concepts of statics, central-force-systems, general force systems, determination of centre of gravity, forces at bearing and joint, trusses, internal forces at the beam and at the frame structure, adhesion and friction. | 1 u. 1 | V | 6 | 4,5 | K90 | 7 | Prof. Dr. T. Streilein<br>Prof. Dr. M. Rambke<br>Prof. Dr. C. Haats |
| M05.2 | Strength of Materials | Tasks of strength theory, loads, stresses and deformation simple stresses (tension/compression, bending, shearing, torsion, buckling) and composite stresses, distortion, equivalent tensile stress hypotheses (von Mises yield criterion), Euler-Bernoulli beam theory, deflection in beams. Calculation of statically determinate and statically indeterminate systems | 2 u. 3 | V | 4 | 2 | K90 | 4 | Prof. Dr. T. Streilein |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **M06** | **Dynamics** | Mastery and application of engineering fundamentals structuring, analysis and solution of corresponding technical problems, and this also includes conceptual, analytical and logical thinking. The students can work with the methods learned in order to model, analyse and evaluate and lay out dynamic systems. For this purpose, they can calculate kinematic motions and kinetic forces and evaluate them. | | | | | | **9** | Prof. Dr. V. Dorsch |
| M06.1 | Dynamics | Plane kinematics of dot masses and rigid bodies: speed, Acceleration, rotation and translation, momentary pole; plane kinetics of the point and the rigid body: Newton's axioms, the law of angular momentum, impact, work-energy principle, mass moment of inertia. | 3 u. 4 | V | 5 | 4 | K90 | 6 | Prof. Dr. V. Dorsch |
| M06.2 | Oscillation theory | Single-mass transducers with and without damping, beginning and ending of oscillation processes, transfer function, different forms of excitation and related solution algorithms, influencing the vibration properties of technical systems. Characterisation of the vibration parameters: Mass, stiffness and damping. Multi-mass oscillator. | 4 u. 6 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. K. Thiele |
| **M07** | **Basics in technical design** | At the heart of the module lies gaining knowledge of design fundamentals and design methodologies as well as learning the skills for analysis, development and implementation of technical solutions by means of various machine elements. | | | | | | **8** | Prof. Dr. A. Ligocki |
| M07.1 | Basics of technical designing | Basics of the description of technical products; introduction to the descriptive geometry; technical freehand drawing; creating technical drawings (dimensioning, cut and cut-out, drawing simplification); dimensional tolerances and fits; surfaces and edges; standardisation and materials. | 1 u. 1 | V+ | 2 | 2,5 | KP (K60 +PA) | 3 | Prof. Dr. A. Ligocki |
| M07.2 | Machine elements I | strength and permissible stresses, static and dynamic strength verification of axles and shafts; design and calculation of screws, as well as dot and seam welding. | 2 u. 3 | V+ | 4 | 3,5 | KP (K90 +PA) | 5 | Prof. Dr. A. Ligocki |
| **M08** | **Advanced technical design** | The module is designed to enable students to develop more specialised engineering skills and to apply according principles for the solution of constructive tasks. The module also aims to significantly improve the student's problem-solving and methodical competence. Thus, the Module enables students to develop design methods suited for given engineering problems and systematically pursue enhancements on their own accord. | | | | | | **12** | Prof. Dr. S. Lippardt |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| M08.1 | Machines-elements II | Geometry of spur and helical gears, load capacity of gears, roller bearings, non-switchable and switchable clutch and brakes. | 3 u. 4 | V+ | 6 | 4,5 | KP (K90 +PA) | 7 | Prof. Dr. U. Triltsch |
| M08.2 | CAD | Basic operation of 3D CAD systems, sketching technology, Depth assignment, reference/ orientation systems, conditions, Boolean operations and depth limitation, simple assemblies, Drawing derivation. | 3 u. 4 | V | 1 | 0,5 | K60 | 1 | Prof. Dr. A. Ligocki |
| M08.3 | Laboratory for CAD | Introduction to the operation of a 3D CAD system, creation of 2D Sketches, generation of solids by the means of different techniques, modelling of the components by means of 3D features, handling of references and conditions, derivation of drawings, Creation of small assemblies. | 3 u. 4 | L | 1 | 0,5 | PA | 1 | Prof. Dr. A. Ligocki |
| M08.4 | Construction Syst-tematics | Basics of systematic design; structure of the design process: planning, conception, design, elaboration; working methods during the design process e.g. information gathering, Morphological scheme and evaluation methods; presentation of the Product over the course of the design process: list of requirements, Functional structure, concept sketches and design representations. | 4 u. 6 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. S. Lippardt |
| **M09** | **Materials Science** | The aim of the module is to acquire knowledge of the structure and properties of metallic materials with a special focus on mechanical engineering in order to evaluate their use/economics in the production process and technical application. | | | | | | **7** | Prof. Dr. I. Nielsen |
| M09.1 | Materials Science | Structure of metallic solids, crystallisation from the melt, alloy formation (phase diagrams), deformation and recrystallisation, introduction to electrochemistry (corrosion, electroplating, battery cell), materials testing, iron-carbon diagram, structure of iron-carbon alloys, heat treatment of steels, steel production, steel groups and their applications, standardisation of steel and cast iron materials, lightweight construction materials (Al and Mg) | 1 u. 1 | V | 4 | 3,5 | K90 | 5 | Prof. Dr. I. Nielsen |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **M10** | **Drivetrain Technology** | Students learn the basics of engineering drivetrain technology. They are enabled to solve stationary drivetrain problems with electric, hydraulic or pneumatic systems. They can analyse, structure and specify stationary drivetrain problems. With the help of the basics learned, the students are able to devise different strategies to solve the problem and to evaluate them. They will learn how to work in a team and how to present the results based on a scientific working method through practical laboratory projects. | | | | | | **8** | Prof. Dr. R. Roskam |
| M10.1 | Electric drives | The students know the basic functional mechanisms of electric drives and can evaluate the advantages and disadvantages. They can perform basic static calculations. | 3 u. 4 | V | 2 | 1 | K90 | 2 | Prof. Dr. R. Roskam<br>Dipl.-Ing. B. Zemmiri |
| M10.2 | Fluidic drives | The students know the essential components of fluidic drives and can explain the advantages and disadvantages of the respective components. They can read and analyse fluidic circuits as well as calculate stationary states. | 3 u. 4 | V | 2 | 1 | | 2 | Prof. Dr. R. Roskam |
| M10.3 | Laboratory for electrical Drives | Direct current machines and asynchronous machines can be operated and analysed with the help of measuring systems. | 4 u. 6 | L | 1 | 2 | PA | 2 | Prof. Dr. R. Roskam |
| M10.4 | Laboratory for fluidic Drives | Fluidic systems can be analysed, assembled and operated by the students. They can define characteristic curves of fluidic elements and use them for simulation. The students can carry out and evaluate simple simulations. | 4 u. 6 | L | 1 | 2 | PA | 2 | Prof. Dr. R. Roskam |
| **M11** | **Measurement and control systems** | Acquisition of basic knowledge of the measurement, monitoring and control engineering; ability to perform structured analysis of simple problems in this field; competence in solving according tasks. | | | | | | **9** | Prof. Dr. X. Liu-Henke |
| M11.1 | Control systems engineering | Description of dynamic systems with differential equations and transfer functions; analysis of the system behaviour over time and in the frequency domain; synthesis of the linear continuous single-loop Control; basic principles of the realisation of control loops. Application of modern design tools like Matlab/Simulink and RCP systems such as dSPACE real-time systems in lectures, continuous demonstration of the methodology using examples from practical applications. | 3 u. 4 | V | 2 | 1 | K60 | 2 | Prof. Dr. X. Liu-Henke |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| M11.2 | Laboratory for control systems engineering | Four laboratory experiments are connected with each other according to the content of the lecture. Experiments: 1 - Modelling of a gantry crane (Mat-lab/Simulink) 2 – Control of a gantry crane (RCP) 3 - Water level- and flow control (industrial controller and bypassing RCP) 4 - Control of a multi-coordinate drive (RCP) | 4 u. 6 | L | 1 | 2 | PA or R | 2 | Prof. Dr. X. Liu-Henke |
| M11.3 | Measurement technology | Systematic and random errors. Gaussian and student distribution. Indication of measurement result. Measuring chain: sensors, measuring circuits (Whetstonian bridge circuit), amplifier and A/D converter. Digi-tal measurement technology: system sampling frequency, aliasing, Nyquist-Shannon sampling theorem, Fourier transform. Demonstration of the methodology using practical laboratory examples. | 3 u. 4 | V | 2 | 1 | K60 | 2 | Dr D. Balan |
| M11.4 | Laboratory for measurement technology | Measurement of forces and torque with strain gauge, as well as measurement of temperature with thermistors in a bridge circuit. Innate amplification of the Wheatstone Bridge Measurement value acquisition and evaluation. | 4 u. 6 | L | 1 | 0,5 | PA | 1 | Dr D. Balan |
| M11.5 | Applied Computer - science | Object Oriented Programming (OOP), functions polymorphism, Inheritance, encapsulation, classes and objects, structures, pointers and References, dynamic memory management, exercises. | 4 u. 6 | V | 2 | 1 | K60 | 2 | Dipl.-Ing. B. Zemmiri |
| **M12** | **Production Engineering** | This module should enable students to work with and designate manufacturing processes suited for the production of given components and assemblies. For the individual production processes, charac-teristics, process limits and the functional and technical requirements can be described in own words. Through the linked terms such as component properties, load, material characteristics, cost, etc. the students approach production-related facts. The students can comprehend the role of manufacturing technology concepts in the operational processes and organisational structures. | | | | | | **7** | Prof. Dr. M. Rambke |
| M12.1 | Production engineering I | Machining processes: turning, milling, drilling, grinding, honing, lapping spark erosion removal, removal with laser beam Forming processes: Sheet metal forming (deep drawing, bending, press forming, other methods of forming (extrusion, roll forming, etc.), solid forming (extrusion, extrusion pressing, forging, rotary swaging, etc.), cold and hot forming, Functionality of the forming machines, types of surface treatment. | 1 u. 1 | V | 3 | 1,5 | K90 | 3 | Prof. Dr. C. Borbe<br>Prof. Dr. M. Rambke |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| M12.2 | Production Engineering II | Joining techniques: industrially relevant processes according to DIN 8580 or 8593: Fusion welding (arc welding, laser welding), electric resistance welding joining by forming; welding defects and their detection, soldering. | 2 u. 3 | V | 2 | 1 | K90 | 2 | Prof. Dr. I. Nielsen |
| M12.3 | Company organisation | Boundary conditions and objectives of production companies; organizational structure and process organisation, procedures and responsibilities, assembly technology. | 2 u. 3 | V | 1 | 0,5 | | 1 | Prof. Dr. C. Borbe |
| M12.4 | Production Engineering II Laboratory | Laboratory tests for materials testing and joining techniques. | 3 u. 4 | L | 1 | 0,5 | PA | 1 | Prof. Dr. I. Nielsen |
| **M13** | **Management** | The aim of this module is to provide students with information beyond basic engineering subjects to achieve more interdisciplinary skills.The competence for networking various specialist areas is thereby strengthened. Through the teaching of project and quality management methods in particular, various skillsets are achieved and enhanced. The student project will especially train the ability to work in a team. The introduction into scientific working methods within the student project lays the groundwork for later projects and demands comprehensible presentation and documentation of results. | | | | | | **12** | Prof. Dr. H. Brügge-man |
| M13.1 | Quality management | Basics of quality management: Elementary tools and Methods of QM, Failure Mode and Effects Analysis (FMEA), Customer-oriented product development and quality planning (QFD), Statistical design of experiments, process capability studies, QM system according to DIN EN ISO 9000, Total Quality Management. | 4 u. 6 | V | 2 | 1 | K60 | 2 | Prof. Dr. H. Brügge-man |
| M13.2 | Business Administration | Organisation, procurement, production, sales, cost accounting, investment, financing, budgeting, controlling, key figures, break-even analysis, human resources, labour law, strategic leadership. | 4 u. 6 | V | 4 | 2 | K90 | 4 | Prof. Dr. C. Haats<br>Prof. Dr. T. Frenzel |
| M13.3 | Law | Introduction to the legal system, BGB (German Civil Code), equipment safety and product safety product liability law, environmental law, patent law. | 4 u. 6 | V | 2 | 1 | K60 | 2 | Prof. Dr. C. Haats |
| M13.4 | Student Project | Basics of project management: planning, organisation and controlling; introduction to scientific work: Procedure and design of project, student research and Bachelor's theses. Project work: development, documentation and presentation of a technical problem solving in a team. Written documentation. | 4 u. 6 | V | 1 | 4,5 | PA | 4 | Prof. Dr. T. Frenzel<br>Prof. Dr. U. Triltsch |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **M14** | **Practical semester/ Internship-semester** | The students are to be introduced to application-oriented activities. They are given the possibility to apply the various disciplines, the knowledge and skills to real complex problems under guidance in an actual workplace environment. They should be introduced to aspects of the operational decision-making processes and their interaction. This includes deepened insights into technical, organisational, economic, legal and social aspects of the operational activities. The ability of the students to successfully implement scientific findings and methods into concrete practical situations will be promoted and developed. | 5 u. 5 | | | | successful participation | **24** | Prof. Dr. C. Heikel |
| **M15** | **Student research project 1** | The students will gain the skills to develop and implement solution strategies. Furthermore, the students are enabled to apply the acquired knowledge from different fields to network with each other in their specialist areas. They are to enhance the skills of presenting ideas and concepts in a reliable and convincing manner. Furthermore, they are to be introduced to practice-relevant tasks as well as processes in the industrial environment. Lastly, they will be enabled to follow a scientific way of working and gain the ability to analyse and structure complex tasks as well as being able to expand their existing knowledge independently. A scientific paper will be written as documentation. | 5 u. 5 | | | | PA | **12** | Prof. Dr. C. Heikel |
| **M16** | **Student research project 2** | See above. | 5 u. 5 | | | | PA | **12** | N.N. |
| **P01** | **mandatory module 1** | see tables „compulsory modules “below | | | | | | **8** | N.N. |
| **P02** | **mandatory module 2** | see tables „compulsory modules “below | | | | | | **8** | N.N. |
| **P03** | **mandatory module 3** | see tables „compulsory modules “below | | | | | | **8** | N.N. |
| **WP01** | **Elective compulsory module 1** | see following table; only elective compulsory modules of the chosen specialisation. | | | | | | **8** | N.N. |
| **WP02** | **Elective compulsory module 2** | Eligible are mandatory and elective compulsive modules of all specialisations. | | | | | | **8** | N.N. |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **M17** | **Language and ethics** | Based on this module, the students should be able to work in internationally operating companies. To this end, they are to be enabled to communicate with colleagues as required and customers and make decisions that are not solely important for technical requirements, but also take social, cultural and environmental aspects into account. | | | | | | **10** | Prof. Dr. C. Haats |
| M17.1 | Technical English | Target competence: B2 (with good previous knowledge, a higher level can also be achieved). Participants have acquired the basics of general English (Vocabulary/grammar/linking techniques and contextual understanding). They are familiar with technical language expressions from the field of materials, graph description, production, description of technical functions and objects. They have focused on topics in the field of mechanical engineering as. material science, engines, fuel cell technology, electromobility. They have the linguistic means to acquire information on the subject from literature, can follow presentations and communicate in an appropriate manner on given topics in written and oral form. | 7 u. 8 | V | 2 | 1 | K60 | 2 | N.N. |
| M17.2 | Technology and ethics | Introduction to ethics (ethical principles, values, morals), actors and Application of ethical guidelines for engineers, methods for socially and environmentally sustainable technology design, understanding of typical ethical dilemmas in the engineering profession based on case studies. | 7 u. 8 | V | 2 | 1 | K60 | 2 | Prof. Dr. C. Bath |
| M17.3 | Elective subject | Courses can be selected from the entire range of courses offered by the university. | 7 u. 8 | V | | | | 2 | N.N. |
| M17.4 | Seminar lecture | Presentation of the results from Student research project 1 or 2 in consultation with the lecturer. | 5 u. 5 | S | | | R | 2 | Prof. Dr. C. Haats |
| M17.5 | Workshop Social competence | Theoretical principles of social behaviour, exercises in behaviour management in accordance with exemplary situations from everyday life in a company. | 5 u. 5 | S | 2 | | successful partic.. | 2 | Prof. Dr. C. Haats |
| | **Bachelor thesis with Colloquium** | The aim of the Bachelor thesis is to develop the ability to analyse, structure and solve complex problems in a practical relevant task. For this purpose, the ability to document and present the results in an appropriate and comprehensive manner is crucial. | | | | | | **14** | Prof. Dr. C. Haats |
| | Bachelor thesis | | 7 u. 8 | b | | | PA | 12 | Prof. Dr. C. Haats |
| | Colloquium | | 7 u. 8 | b | | | Kq | 2 | Prof. Dr. C. Haats |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
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## Compulsory modules of the specialisation in design and development

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|---|---|---|---|---|---|---|---|---|---|
| **PK1** | **Applied Design** | Students are given a solid foundation and professional knowledge in the field of construction with modern materials. Within the module, the focus lies on the selection of suitable design and development methods as well as in the analysis and evaluation of existing and planned designs. The production for the development and implementation of solution strategies is further deepened within this module. | | | | | | **8** | Prof. Dr. S. Lippardt |
| PK1.1 | Cost-effective designing | Value analysis and target costing; basics of cost accounting (surcharge calculation, machine hour rates); procedures of Preliminary costing accompanying the design (cost estimate, cost structures, prices of purchased parts, relative cost information, short calculation based on a simplified work plan); cost effective design (production- and assembly-oriented design). | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. S. Lippardt |
| PK1.2 | Plastics construction and design | Structure and classification of plastics, material properties, Dimensioning of plastic components, stress resistant Design, production oriented design, ribs and other methods for increasing stiffness, connecting elements, practical design examples | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. T. Streilein |
| PK1.3 | Management of development projects and PDM | Management of the product development process, definitions, typical project phases, leadership and teamwork, information management process parallelization, project planning, quality management methods in development, project and product data management systems. | 6 u. 7 | V | 2 | 1 | PA | 2 | Prof. Dr. U. Triltsch |
| **PK2** | **Development methods** | Students can use modern computer programs to control and monitor their work in design and development. They are able to design component groups in CAD and to monitor their properties by means of FEM. The students have acquired the necessary specialist knowledge. They can solve the technical problems and analyse, structure and formulate the results. They are able to develop and implement solution strategies and select suitable methods on the way. They can present the results of their work in a convincing manner. | | | | | | **8** | Prof. Dr. S. Lippardt |
| PK2.1 | FEM | Theoretical basics of FEM, implementation of a Finite Ele-mente analysis (create model, define boundary conditions, discretisation, analysis settings and simulation, interpretation of the | 6 u. 7 | V | 4 | 3,5 | K90 | 5 | Prof. Dr. K. Thiele<br>Prof. Dr. S. Lippardt |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| | | analysis results) dimensional reduction, working with contact, plastic deformation, static strength verification and Fatigue strength verification, vibrations (modal analysis), thermal analyses. | | | | | | | |
| PK2.2 | Advanced techniques in 3D-CAD | Specialisation in component technologies, assemblies and assembly techniques. internal and external references, parametrics, formula relations component families | 6 u. 7 | V | 2 | 2,5 | PA | 3 | Prof. Dr. A. Ligocki |
| **PK3** | **Component and power unit development** | Ability to analyse and structured solution of integral problems of complex machines and power train systems. This includes the selection and correct application of suitable methods for modelling and numerical solution. Additonally, the competence to network different fields of expertise is to be developed using the example of power unit design. | | | | | | **8** | Prof. Dr. K. Thiele |
| PK3.1 | Machine Dynamics | Basics of modelling. Determination of characteristic values (Mass moment of inertia, springs and dampers). Model of the rigid machine and its creation and calculation. Foundation of the rigid machine. Torsional and bending vibrations in drive trains. | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. K. Thiele |
| PK3.2 | Heat engineering and Energy Management | Contents: Irreversible processes. Exergy and anergy of enthalpy, closed systems and heat. Basics of heat-transfer in form of heat conduction, convection and radiation. learning objectives: The lecture is an important basis for many fields of study in mechanical engineering (conversion of energies and heat flow). The students will develop an understanding of how to perform tasks around energy conversion and heat flow using different chapters of thermodynamics. Furthermore, typical applications of the above-mentioned contents should be analysed and evaluated. | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. C. Heikel |
| PK3.3 | Tribology | Tribological basics (tribological systems, stress, friction, wear, lubrication). Tribometry and tribomaterials (tribological measuring and testing technology, analytic methods in tribology, tribomaterials) Technical tribology (tribology of construction elements, tribological problems in production engineering, tool tribology, tribology in engines and transmissions). | 6 u. 7 | V | 2 | 1 | K60 | 2 | Prof. Dr. I. Ahmed |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
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## Compulsory modules of the specialisation propulsion and vehicle technology

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **PA1** | **Vehicle conception** | Specialisation for analysis, conception and development of powered vehicles, structuring and analysis of technical problems including resolution of complex problems with conflicting objectives. For this purpose, skills for the conversion of solution strategies are taught. Application of this knowledge enables the students to analyse vehicles and design concepts. They know the target requirements for vehicle characteristics and the influence of parameters to these and can thus optimize their vehicle concepts. This complex development process can be handled by the students mastering the skills and the methods learned. | | | | | | **8** | Prof. Dr. V. Dorsch |
| PA1.1 | Vehicle Dynamics | longitudinal dynamics: tyre slip and dynamic radius, driving resistances, influence of clutch and gearbox, tractive force diagram with determination of driving performance, fuel consumption, dynamic shift of forces during acceleration and braking, Driving limits, brake force distribution and braking distance. Vertical dynamics: Vibrations caused by uneven road surfaces, models for vehicle suspension and damping, rolling. handling: Single-track model, self-steering behaviour: Over- and understeer. | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. V. Dorsch |
| PA1.2 | Vehicle drive trains | Contents: System view of the vehicles regarding energy storage, energy converter and torque converter up to the required power at the wheel. Basics of the drive train technology, special requirements of the mobile drive train, thermal and electric engines. Interaction of transmission, converters, engines, energy storage systems, hybrid drive concepts. The students should be able to analyse and evaluate current drive systems in terms of energy and performance. | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. C. Heikel |
| PA1.3 | Management of development projects and PDM | Management of the product development process, definitions, typical project phases, leadership and teamwork, information management process parallelization, project planning, quality management methods in development, project and product data management systems. | 6 u. 7 | V | 2 | 1 | PA | 2 | Prof. Dr. U. Triltsch |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **PA2** | **Vehicle construction** | In this module, students acquire well-founded, subject-specific knowledge in the field of vehicle design. The skills to analyse technical problems, implement suitable solution strategies and plan in a logical and conceptual manner will be deepened. Further subject within the module is the systematic development of design methods. | | | | | | **8** | Prof. Dr. T. Streilein |
| PA2.1 | Surface engineering and technology | Surface stress. Corrosion. Surface pre-treatment. Electroplating with and without electricity. PVD and CVD. Conver-sion layers. Organic layers. Hot dip & diffusion layers. Enameling. Thermal spraying. Laboratory tests. | 6 u. 7 | V+L | 2 | 2,5 | KP (K60 +PA) | 3 | Prof. Dr. I. Ahmed |
| PA2.2 | Lightweight construction | Design principles of lightweight construction, lightweight construction methods, lightweight materials, calculation & dimensioning of lightweight construction numerical calculation methods, thin-walled profile beam structures, two-dimensional structural systems, special bearing elements of lightweight construction and such as practical design examples under lightweight construction aspects. | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. T. Streilein |
| PA2.3 | Car Body Development | Body structure & modes of design, development process, stiffness relevant design, strength-relevant design, crash design and lightweight body construction as well as practical design examples. | 6 u. 7 | V | 2 | 1 | K60 | 2 | Prof. Dr. T. Streilein |
| **PA3** | **Component and power unit development** | Ability to analyse and structured solution of integral problems of complex machines and power train systems. This includes the selection and correct application of suitable methods for modelling and numerical solution. Additonally, the competence to network different fields of expertise is to be developed using the example of power unit design. | | | | | | **8** | Prof. Dr. K. Thiele |
| PA3.1 | Machine Dynamics | Basics of modelling. Determination of characteristic values (Mass moment of inertia, springs and dampers). Model of the rigid machine and its creation and calculation. Foundation of the rigid machine. Torsional and bending vibrations in drive trains. | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. K. Thiele |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| PA3.2 | Heat engineering and Energy Management | Contents: Irreversible processes. Exergy and anergy of enthalpy, closed systems and heat. Basics of heat-transfer in form of heat conduction, convection and radiation. learning objectives: The lecture is an important basis for many fields of study in mechanical engineering (conversion of energies and heat flow). The students will develop an understanding of how to perform tasks around energy conversion and heat flow using different chapters of thermodynamics. Furthermore, typical applications of the above-mentioned contents should be analysed and evaluated. Contents: Irreversible processes. Exergy and anergy of enthalpy, closed systems and heat. Basics of heat- | 6 u. 7 | V | 2 | 2,5 | K60 | 3 | Prof. Dr. C. Heikel |
| PA3.3 | Tribology | Tribological basics (tribological systems, stress, friction, wear, lubrication). Tribometry and tribomaterials (tribological measuring and testing technology, analytic methods in tribology, tribomaterials) Technical tribology (tribology of construction elements, tribological problems in production engineering, tool tribology, tribology in engines and transmissions). Tribological basics (tribological systems, stress, | 6 u. 7 | V | 2 | 1 | K60 | 2 | Prof. Dr. I. Ahmed |

## Compulsory modules of the specialisation in mechatronics

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **PM1** | **Theory of mechatronic systems** | Deepening of the system theory of mechatronics; ability to work in the field of model based, computer-assisted controller and system design for solution of problems in mechatronic systems; Confidence in working with modern CAE methodology and CAE tools. | | | | | | **8** | Prof. Dr. X. Liu-Henke |
| PM1.1 | Advanced Control systems engineering | Description of the dynamic system using a locus curve, Bode plot and state space representation. Frequency behaviour of the open and closed control loop, Nyquist stability criterion, synthesis by means of frequency characteristic method, extended control structure with pre-filter and pre-control, disturbance variable, cascade control basic principles of status control, method of pole specification. Use of modern design tools (Matlab/Simulink and RCP-systems - dSPACE real-time systems) in the lecture, continuous demonstration of methodology using examples from practical applications. | 6 u. 7 | V | 4 | 3,5 | K90 | 5 | Prof. Dr. X. Liu-Henke |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| PM1.2 | Simulation | Modelling and simulation of dynamic systems using modern simulation tools (Matlab/Simulink): Introduction to Matlab/Simulink modelling of dynamic systems with the aid of differential equations and transfer functions,numerical integration methods, modal reduction, Presentation and interpretation of simulation results. | 6 u. 7 | V | 2 | 2,5 | PA | 3 | Prof. Dr. C. Hartwig |
| **PM2** | **Information technology** | Students learn the basics of engineering in the field of microcontrollers and programmable logic controllers. They are enabled to carry out control tasks with the aid of SPS or microprocessor control systems For this purpose, they can analyse, structure and specify the control task. They are proficient in methods suited to solve these tasks conceptually and logically. Through practical projects, students learn cooperation in a team and presentation of the results based on scientific working methods. | | | | | | **8** | Prof. Dr. R. Roskam |
| PM2.1 | Microcontroller | Students can perform control tasks with the aid of micro-controllers. This includes the conception of the hardware as well as programming and testing of the software. | 6 u. 7 | V | 3 | 3 | PA | 4 | Prof. Dr. R. Roskam |
| PM2.2 | Actuator/control engineering | The students can perform control tasks with the help of a memory programmable controller. This includes the conception of the hardware as well as the programming and testing of the software. | 6 u. 7 | V | 3 | 3 | PA | 4 | Dipl.-Ing. B. Zemmiri |
| **PM3** | **Measuring and circuits** | With the help of the acquired in-depth technical knowledge, the students possess the competence to analyse, interpret and solve problems of electronic circuits in a structured way, as well as to calculate them. They have skills in appropriate methods for measurement data acquisition and to use the acquired data in a systematic way and further process them in a targeted manner. | | | | | | **8** | Prof. Dr. C. Hartwig |
| PM3.1 | Sensor technology and Measurement data-processing | Design, layout and application areas of sensors. Advantages and disadvantages presented on examples. Static and dynamic properties. Bus systems and protocols, transmission rate and Latency, system sampling frequency. Modulation types, ISO-OSI reference Model. Practical design of analogue multi-device measurement layouts. Filters. Operational amplifiers in different applications. A/D converter and D/A Converter processes. LabView programming. | 6 u. 7 | V | 3 | 3 | K90 | 4 | Dr D. Balan |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| PM3.2 | Circuit technology | Voltage stabilisation with a Z-diode; current stabilisation with a junction field effect transistor; switching amplifier and pulse width modulation (frequency converter); stabilised power supplies; optocouplers; automotive sensor technology; combinatorial and sequential digital circuits; electromagnetic compatibility. | 6 u. 7 | V | 3 | 3 | K90 | 4 | Prof. Dr. C. Hartwig |

## Compulsory modules of the specialisation in production and logistics

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **PP1** | **Forming and Machining** | Based on production Engineering I (1st semester), the module will enable students to evaluate machining and forming production processes and to plan them. For this purpose, they learn the handling of process-specific process limits as well as calculation methods for determining process parameters. | | | | | | **8** | Prof. Dr. M. Rambke |
| PP1.1 | Forming Technology | Basics of plasticity theory (Mohr's circle, flow stress, flow areas) and practical application in sheet metal forming, cold working and hot working (measurement and calculation of deformations, stress states, forces, etc.). | 6 u. 7 | V+L | 3 | 3 | KP (K60 +R) | 4 | Prof. Dr. M. Rambke |
| PP1.2 | Machining technology | Tipped tool geometry, chip types, chip shapes, influencing variables of the shape of chips, measurement and calculation of tool stress, phenomena of tool wear and tear. Cutting tool materials, coatings, economic design of machining processes. | 6 u. 7 | V+L | 3 | 3 | KP (K60 +R) | 4 | Prof. Dr. C. Borbe |
| **PP2** | **Assembly and Quality Engineering** | Aim of this module is a deepening of the knowledge in the field of handling and assembly technology and quality management. The analysis and formulation of complex problems in these areas as well as the application of appropriate methods and solution strategies are taught. | | | | | | **8** | Prof. Dr. H. Brügge-man |
| PP2.1 | Handling and Assembly technology | Basics of handling and assembly technology, feeding systems, robot systems, assembly systems, planning of assembly systems, product design suitable for assembly, case studies for handling and assembly technology, programming exercises and tasks for positioning of robots in the laboratory. | 6 u. 7 | V+L | 3 | 3 | KP (K60 +PA) | 4 | Prof. Dr. H. Brügge-man |
| PP2.2 | Advanced Quality management | QM in goods receipt, supplier evaluation, statistical process control, test planning, test equipment monitoring, quality audits, quality assurance | | V+L | 3 | 3 | KP (K60 | 4 | Prof. Dr. H. Brügge-mann Prof. Dr. U. |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| | | costs, CAQ, continuous improvement processes. Dimensional standards, measuring methods, measuring errors, test equipment capablility coordinate metrology, coordinate measuring technology. | | | | | +PA) | | Triltsch |
| **PP3** | **Production-management and Logistics** | The competitive advantages of manufacturing companies in times of global availability of production technology are increasingly difficult to achieve purely by technical means. The company organisation for many companies is becoming a critical success factor. The aim of this module is to provide the students with knowledge of production management and logistics as well as practical and application-oriented problem-solving and methodological skills for optimised internal and external organisation of the value chain. | | | | | | **8** | Prof. Dr. C. Haats |
| PP3.1 | Production Planning and control | Basic principles of business organisation, forms of organisation in production and assembly; forms of order processing; product structure/ Parts list; work plan; production programme planning; demand planning; Scheduling; capacity/load planning; balancing of production lines; disposition; order initiation/ order monitoring; production control; case studies production management; elements of value stream design. | 6 u. 7 | V | 2 | 1,5 | K90 | 2,5 | Prof. Dr. C. Haats |
| PP3.2 | Basics of Logistics | History of logistics; logistics systems: Definitions and targets; logistic tasks; Fundamentals of material logistics; Loading aids; storage technology for break bulk cargo; conveyor technology for break bulk cargo (continuous and discontinuous conveyors). | 6 u. 7 | V | 2 | 1,5 | | 2,5 | Prof. Dr. C. Haats |
| PP3.3 | Operation of machine tools | Requirements, design, selection of machine tools; components in contact with the piece; process monitoring, evaluation of accuracy, audit and commissioning of machine tools; Multi-machine systems; comparison of economic efficiency | 6 u. 7 | V | 2 | 2,5 | | 3 | Prof. Dr. C. Borbe |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|

## Elective modules Bachelor's programmes in Mechanical Engineering (BM) / Mechanical Engineering in Practical Training (BMP)

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **WK1** | **Applied fluid mechanics** | Profound technical knowledge in fluid mechanics, aerodynamics and applied assemblies such as turbines, turbochargers, wind turbines etc. Methodological competence: Skills for logical, analytical and conceptual thinking, selection and confident application of appropriate methods. Practical experience and professional qualification: Knowledge of practical tasks, getting to know processes in an industrial environment, skills to solve problems under industrial conditions. | | | | | | **8** | Prof. Dr. F. Klinge |
| WK1.1 | Technical Aero-dynamics | Description of the boundary layer development, fluid friction, flow forms and the possibilities of influencing them builds the groundwork for a deeper understanding of fluid mechanics. Teaching of application examples makes it easier to understand the theory by analysing existing solutions. | 7 u. 8 | V | 3 | 3 | KP (K90 +R) | 4 | Prof. Dr. F. Klinge |
| WK1.2 | Wind power, turbines and turbocharger | Presentation of the theoretical bases of interpretation of the most Turbomachinery: pumps, water and wind power plants, turbines and turbocharger. Description of the backgrounds based on existing constructions. Operation of a gas turbine, wind tunnel and Water turbine and other machines in the laboratory. | 7 u. 8 | V | 3 | 3 | | 4 | Prof. Dr. F. Klinge |
| **WK2** | **Construction of Machines** | The aim of the module is the subject-specific consolidation of knowledge in the field of mechanical assemblies. The students aim to be able to perform technical tasks well by developing suitable novel mechanical constructions. They will acquire the ability to design mechanical assemblies in a suitable way to achieve set goals at low cost. | | | | | | **8** | Prof. Dr. S. Lippardt |
| WK2.1 | Designing and layout in mechanical engineering | Techniques for the display of designs; determination of performance data of new technical products; principles for functionally appropriate layout, selection of materials, semi-finished products and manufacturing processes; Product structuring as well as selection and use of connection elements; rough dimensioning of components. Production-oriented design of machined components, Design of machined components, sheet metal constructions, iron and steel castings and welded constructions; Selection and dimensioning of supplier components; avoidance of damage. | 7 u. 8 | V | 4 | 3,5 | KP (PA+ LEK) | 5 | Prof. Dr. S. Lippardt |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| WK2.3 | Ergonomics and industrial design | Ergonomic and safety-oriented design of technical products; ergonomics and usability; theory of multiple resource use; Human-Machine System; Basics of Anthropometry; Informational-mental ergonomics; information transfer, -detection, -compatibility; display forms; information delivery. | 7 u. 8 | V | 2 | 2,5 | PA | 3 | Prof. Dr. A. Ligocki |
| **WA1** | **Automotive Engineering** | Specialisation for analysis, conception and development of motor vehicles, which requires structural problems to be solved and analysed, as well as complex problems with conflicting objectives. The students can use the acquired knowledge to analyse vehicles and develop solutions according to given requirements. These are to be evaluated and optimised in consideration of target values. Thus, they obtain the competence to solve technical problems in vehicle development. | | | | | | **8** | Prof. Dr. V. Dorsch |
| WA1.1 | Propulsion and brakes | In-depth examination of the driving resistances with possibilities of reduction considering conflicting objectives, drive map, Types and characteristics of converters (clutches, gear boxes) drive train, drive system types including all-wheel drive, brakes, Brake control systems, tyres. Knowledge of solutions in the field of powertrain and brakes with advantages and disadvantages, targeted optimisation under consideration of boundary conditions and target values conflicts. Practical deepening of knowledge through laboratory tests with a test vehicle in small groups. | 7 u. 8 | V+L | 3 | 3 | KP (K90 +R) | 4 | Prof. Dr. V. Dorsch |
| WA1.2 | Chassis Technology | Lateral and vertical dynamics of the vehicle: tyres, single-track model, Understeer and oversteer, stationary and transient manoeuvres for assessment of driving behaviour, methodology for the evaluation of driving behaviour (subjective - objective correlation), wheel suspensions, elastokinematics, suspension and damper designs, roll and effect of the stabilisers, semi-active and active vehicle dynamics control systems simulation models for lateral and vertical dynamics. Knowledge of existing solutions in the area of chassis, suspension and damping with respective advantages and disadvantages, target-oriented optimisation considering boundary conditions and conflicting objectives. Practical deepening of knowledge through laboratory tests with test vehicle in small groups. | 7 u. 8 | V+L | 3 | 3 | | 4 | Prof. Dr. V. Dorsch |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **WA2** | **Drive Technology** | Understanding and comprehension of the complex drive technology of mobile<br>machines. Specialist knowledge of the forces acting and the requirements of<br>and analysis and development of appropriate construction and groups Selection and safe application of suitable methods for Analysis of internal combustion engines. Development of the ability to analyse and structure the development process of Internal combustion engines | | | | | | **8** | Prof. Dr. C. Heikel |
| WA2.1 | Piston engines | Contents: Components of piston engines and their manufacturing, materials and stress under operating load: piston, connecting rod, crankshaft, crankcase, oil sump, balancer shafts, injection systems, valves and valvetrains including adjustable camshafts, cylinder head, supercharging, exhaust gas purification systems. Examples of current reciprocating piston engines.<br><br>Practical training in the laboratory for piston engines.<br><br>Learning objectives: The students get an overview of the components of the piston engine. They are able to evaluate the production processes, the materials and the stress on components as well as to carry out analyses. | 7 u. 8 | V+L | 2 | 2,5 | KP (K90 +R) | 3 | Prof. Dr. C. Heikel |
| WA2.2 | Combustion engines | Contents: Classification of the piston engine within the field of energy converters, characteristics, overview of the structure of reciprocating piston engines and their kinematics and dynamics, characteristic diagrams, thermodynamic basics (circular processes, comparative processes, real circular process), charging, air-fuel-mixture formation, fuels, intake, compression, combustion and exhaust in the four-stroke engine, exhaust gases, exhaust aftertreatment.<br><br>Practical training in the laboratory for piston engines.<br><br>learning objectives: The students get an overview of the complete field of combustion engines. They can analyse and evaluate according characteristic curves. The basics of the Energy conversion from charging to combustion and the exhaust gases and their treatment are understood and can be applied. | 7 u. 8 | V+L | 4 | 3,5 | | 5 | Prof. Dr. C. Heikel |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **WM1** | **Mechatronic System development** | The students have methodical competence in the solution of mechatronics system developments, especially in the field of propulsion systems. They know the technical basics of mechatronic systems and can use them to solve complex propulsion tasks in a structured way. | | | | | | **8** | Prof. Dr. R. Roskam |
| WM1.1 | Development process of mechatronic systems | The students learn methods for structured solutions of mechatronic problems. This includes simulation, Rapid control prototyping, integration on a microcontroller and testing by hardware-in-the-loop. They can use the required tools safely and transfer them to new problems. | 7 u. 8 | V | 2 | 2,5 | PA | 3 | Prof. Dr. R. Roskam |
| WM1.2 | Mechatronic drive systems | Students can learn the system development for mechatronic drive systems. This includes the creation of a simulation, determination of simulation parameters, the validation of the simulation, the commissioning of different control circuits for electrical and fluidic drive systems. | 7 u. 8 | V | 4 | 3,5 | | 5 | Prof. Dr. R. Roskam |
| **WM2** | **Vehicle-Mechatronics** | Acquisition of specialist knowledge about embedded control systems in the automotive field; skills for systematic analysis of mechatronic components and their high degree of complexity in vehicles; competence in method development for model-based, computer-aided functional design and validation for electronic control units in vehicles. | | | | | | **8** | Prof. Dr. X. Liu-Henke |
| WM2.1 | Real-time simulation and HIL | Introduction to vehicle mechatronics, introduction to model based design methods for embedded control systems, real-time simulation, components of a HiL test bench, basic features of the digital control algorithm, signal processing, HiL test benches from the current application in the automobile as examples. Use of modern Software and hardware for real-time simulation in lecture and laboratory (Matlab/Simulink/RTW, ControlDesk of the dSPACE-RCP-real-time systems). | 7 u. 8 | V | 3 | 3 | PA | 4 | Prof. Dr. X. Liu-Henke |
| WM2.2 | Driving Dynamics control | Basics of driving dynamics, control of vertical dynamics, brake and lateral dynamic control systems, active steering, integrated vehicle dynamics control systems. Testing of a steer-by-wire system with various driving manoeuvres in the laboratory. | 7 u. 8 | V | 3 | 3 | | 4 | Prof. Dr. X. Liu-Henke |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| **WP1** | **Machine tools** | The students know the structure of machine tools and their control system. They can select machine tool concepts for typical industrial production tasks, design the setup accordingly and to assess the performance of the machinery in operation. The module is essential in the acquisition of sound specialist knowledge in the specialisation "Production and Logistics". It also serves to acquire problem-solving skills by Interdisciplinary knowledge of, among other things, mechanics, manufacturing technology, measurement and control technology as well as propulsion technology. | | | | | | **8** | Prof. Dr. C. Borbe |
| WP1.1 | Machining machine tools | Requirements, structure, designs, components, components in contact with the piece, control system, working accuracy, multi-machine systems | 7 u. 8 | V+L | 2 | 1,5 | K90 | 2,5 | Prof. Dr. C. Borbe |
| WP1.2 | Forming machine tools | Construction of presses and special forming machines (frame, bearing, propulsion, control). Assessment of the machine concepts regarding their use in sheet metal and solid forming processes. | 7 u. 8 | V+L | 2 | 1,5 | | 2,5 | Prof. Dr. M. Rambke |
| WP1.3 | Control of manufacturing systems | CNC for axes and drives, control of tools and auxiliary equipment, materials, handling and transport, measuring technology in manufacturing systems sensors, data interfaces, higher-level control systems, and data collection, data processing. | 7 u. 8 | V | 1 | 2 | K60 | 2 | Prof. Dr. U. Triltsch |
| WP1.4 | Laboratory Control of manufacturing systems | NC programming exercises on PC. Optimised production times, Optimised processing steps and production simulation are taught. | 7 u. 8 | L | 1 | 0,5 | PA | 1 | Prof. Dr. U. Triltsch |
| **WP2** | **Vehicle production** | This module is designed to enable students to assess manufacturing processes for sheet metal and plastics in the automotive industry under technical and economic aspects. For this purpose, they are enabled to assess the product characteristics in their selection process. | | | | | | **8** | Prof. Dr. M. Rambke |
| WP2.1 | Sheet metal processing chain | Functionality and process limits of deep drawing, hydroforming, press hardening, shearing, blanking and piercing. Application of forming simulation (incremental FEM and One-step method) for feasibility analysis in the product development process. | 7 u. 8 | V+L | 3 | 3 | KP (K60 +PA) | 4 | Prof. Dr. M. Rambke |

| Module | Module / Courses | Module goal / learning contents | Sem. BM/BMP | LV | SWS | self study | exam type | Credit Points | Lecturer |
|---|---|---|---|---|---|---|---|---|---|
| WP2.2 | Plastics and Composite plastics | Structure of plastics, classification of plastics, physical and technological properties of plastics; processing of plastics by extrusion and injection moulding; forming and joining of plastics; structure, properties and production of fibre-reinforced plastics. | 7 u. 8 | V+L | 3 | 3 | KP (K60 +PA) | 4 | Prof. Dr. I. Nielsen |
| **WP3** | **Logistics and information technology** | The organisation of the flow of goods is becoming increasingly complex and more of a competitive factor for manufacturing companies. Furthermore, information technology has become an essential part of modern logistics concepts and integrates production and logistics with other company divisions. Goal of this module is to acquire specialist knowledge in the subject area "Logistics and information technology" as well as practical and application-oriented problem-solving and methodological competence for design and optimisation of logistic processes. | | | | | | **8** | Prof. Dr. C. Haats |
| WP3.1 | Procurement and Distribution logistics | Basics of marketing logistics; traffic and handling technology; Picking technology; demand planning; make or buy, outsourcing; Material control (disposition); supplier selection and procurement, goods receipt; material provision; distribution systems; material handling and distribution channels; packaging and load securing; outgoing goods; just-in-time logistics; supply chain management | 7 u. 8 | V | 2 | 1,5 | K90 | 2,5 | Prof. Dr. C. Haats |
| WP3.2 | Information Systems in logistics | Aims, tasks and information need in logistics; structure and functions of common technical and business management oriented Information systems; structure, functions and data structures of ERP/PPS and SCM systems; integration of information systems internal and external; e-business; case studies. | 7 u. 8 | V | 2 | 1,5 | | 2,5 | Prof. Dr. C. Haats |
| WP3.3 | Simulation in Pro-production and logistics | Fundamentals of simulation technology; Digital Factory, fields of application in Production and logistics; material flow and process simulation exercises with Siemens plant simulation/process designer. | 7 u. 8 | V+L | 2 | 2,5 | PA | 3 | Prof. Dr. H. Brügge-mann |

SWS and self-study in time hours per week, the sum of both equals the total time spent on the course. Including the examination period, the course extends over 18 weeks, the semester has a total of 23 weeks: (52 weeks per year - 6 weeks standard leave)/2.