Appendix 2: Module Catalogue

Bachelor's degree study programme in Mechanical Engineering (work-integrated)

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Please note: The German version of this document is the legally binding version. The English translation provided here is for information purposes only.

Introduction to the Engineering Profession								MBM-1 EIB
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
1.1	**150 h**	**5**	1st sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	118 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	16 h			40	

2 Learning outcomes / competences

The students know the historical development of the engineering profession, have an overview of the characteristics of the engineering fields and insight into studies, further education and career opportunities. They are familiar with the basic concepts of the market and the organisation of an industrial company. They can present and explain the contributions of the specialist departments to the development of a consumer or investment good and the interfaces between the departments involved. Students are able to analyse and discuss ethical issues in the engineering profession.

3 Contents

Emergence of the engineering profession

- Training for Bachelor or Master of Engineering
- Engineers in modern industrial companies
- Market, purchasing power, supply and demand, goods, needs
- The industrial enterprise: Goals, competitive strategies, fields of activity, information flows, business software
- Sectors and main activities of the engineer
- The engineer and soft skills and ethical issues

4 Participation requirements

None

5 Form of assessment

Written exam or project work

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Daniel Paßmann

9 Other information

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Mathematics 1								MBM-1 MA1
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
1.2	**150 h**	**5**	1st sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar					
	Supervised self-study	32 h			40	

2 Learning outcomes / competences

The participants acquire the ability to analyse real-valued functions with confidence in order to determine arbitrary properties of interest: They obtain familiarity with common function types and the mathematical notation and have mastered calculations utilising real and complex numbers. They are able to determine the inverse function (or an appropriate local branch) and can routinely analyse rational functions in order to correctly sketch the function graph qualitatively. They are familiar with limit values of sequences and function values, utilised, for example, to determine asymptotic behaviour of functions. They are able to correctly derive real functions and can systematically utilise this knowledge to perform function analysis and curve sketching. Furthermore, they are able to linearise a given function and understand the general idea of function approximation behind this process. Finally, they master integration up to "integration based on Partial fraction decomposition" and can apply integration methods in order to determine geometric area calculations.

3 Contents

Basics

- Number ranges, terminology, symbols, knowledge of basic functions
- Arithmetic of complex numbers

Analysis I

- Sequences and limits
- Real functions of one variable
  - Reverse functions
  - Analysis of rational functions
- Differential calculus of one variable
- Integral calculus of one variable

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Tilman Hetsch

9 Other information

Participation in the preceding preparatory course and the tutorials is strongly recommended.

Material Science and Testing 1								MBM-1 WK1
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
1.3	**150 h**	**5**	1st sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with	40	German
	Exercise	1 SCH/12 h		self-study materials	40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students know the most important metallic and non-metallic materials, their properties and operating behaviour. They are able to explain the atomic structure, the interactions between the atoms and thus the formation of materials structures. They understand lattice defects as the basis for alloy formation, deformation behaviour and heat treatment processes. Students learn about the solidification process of metallic melts and diffusion processes. They can read and interpret state diagrams. They are able to describe how the processes of solidification and forming affect the properties of the metals. Students understand CCT and TTT diagrams as a basis for heat-treatment procedures.

3 Contents

Structure of metallic materials

- Basics, atomic models, lattice structure, lattice structure errors

Phase transformations

- homogeneous and heterogeneous nucleation
- Transformation diagrams, iron-carbon diagram

Behaviour of the metals during thermal activation and mechanical loading

- Thermally activated reactions
- Behaviour of metals under mechanical stress

Primary and secondary forming and heat treatment of metallic materials

- Basic considerations, thermal processes
- Ferrite, pearlite, martensite and bainite formation
- continuous and isothermal CCT and TTT diagrams
- Tempering, embrittlement ranges, thermal and thermochemical side effects

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Engineering Mechanics 1 – Statics								MBM-1 TM1
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
1.4	**150 h**	**5**	1st sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students learn the basic interrelationships of statics as the science of the equilibrium of forces in and on mechanical structures in static load and are able to apply its methods.
They are able to apply the axioms of statics, to create free-body diagrams, to carry out equilibrium investigations analytically on plane or spatial examples and to calculate centres of gravity. Furthermore, they can analyse stability problems and force systems with friction.

3 Contents

Introduction
- Dimensions and units, characteristics and representation of a force

Force system
- Axioms of statics
- Forces with a common point of application, general systems of forces

Determine the support reactions and internal forces for
- one-piece systems of rigid bodies in the plane
- multi-part systems of rigid bodies

Center of mass
- Volume, area and line centre of gravity
- Stability, Guldin's rules

Friction
- Static friction, sliding friction, rolling resistance and belt friction

The spatial force system

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM / ELM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Machine Elements – CAD 1								MBM-1 KE1
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
1.5	**150 h**	**5**	1st sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are taught about the function and structure of selected construction elements and their design. The students are able to explain the function of the presented construction elements and to document them according to standards. The students can model 3-dimensional components independently on the computer. They master different working techniques for 3D model creation and for standard-compliant 2D drawing derivation. They will be able to create drawing derivations including dimensions suitable for production. Selected machine elements can be selected and designed by the students according to their function.

3 Contents

Basics of construction

- Overview of the constructive development process
- Standards of technical documentation
- Tolerances and fits, fitting systems, surfaces
- Design

Selection and design of bearing arrangements

- Rolling bearing
- Plain bearing

CAD 3D Introduction

- Graphic representation, views/perspectives, help functions
- Basics for part production
- Feature modelling, parametric modelling
- Derivation to the standard-compliant 2D drawing

4 Participation requirements

None

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM / ELM

8 Module coordinator

Prof. Dr.-Ing. Andreas Tenzler

9 Other information

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Mathematics 2								MBM-2 MA2
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
2.1	**150 h**	**5**	2nd sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar					
	Supervised self-study	32 h			40	

2 Learning outcomes / competences

The participants acquire the ability to approximate real functions by means of Taylor polynomials. They know the Taylor series of important functions and the significance of the radius of convergence. They are proficient in vector calculus, can confidently handle the basic elements (point, straight line, planes) of analytical geometry and calculate the distances and intersections of objects derived from these elements. They are familiar with the manipulation of matrices and can solve arbitrary linear systems of equations with the help of the Gaussian algorithm, non-quadratic systems included. They understand the underlying theory about the number of solutions in over-, under- and uniquely determined systems and can evaluate determinants up to Sarrus' rule. Finally, they can determine inverse matrices and use them to solve matrix equations. Furthermore, the calculus of multivariable functions is discussed in detail: In differential calculus, they can confidently calculate tangent planes, the gradient or directional derivatives and determine the location and type of critical points. With respect to multivariable integration they can select appropriate coordinate systems and solve integrals, for example, to determine areas, volumes, centres of gravity or moments of inertia.

3 Contents

Linear algebra

- Vector and matrix calculus & analytical geometry
- Linear systems of equations & inverse matrices

Analysis II

- Taylor polynomials and Taylor series for functions of single variable
- Differential calculus for multivariable functions
  - Partial derivatives, local extrema, gradients, directional derivative
- Integral calculus for multivariable functions
  - Cartesian, polar, cylindrical and spherical coordinate systems

4 Participation requirements

Formal: None; Requested: Good working knowledge from the module "Mathematics 1"

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Tilman Hetsch

9 Other information

Participation in the accompanying tutorials is strongly recommended.

Material Science and Testing 2								MBM-2 WK2
No.	**Workload**	**Credit Points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
2.2	**150 h**	**5**	2nd sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students learn about the most important metallic and non-metallic materials, their properties and operating behaviour. They are able to understand methods of surface layer heating and thermochemical processes in carburising and nitriding processes. They understand precipitation processes as a way of increasing strength. The students can define the different manufacturing techniques and derive the different areas of application of metallic materials based on their chemical compositions. Furthermore, they can estimate manufacturing-related influences on the component properties and thus indicate defects of manufacturing.

3 Contents

Heat treatment of metals

- Ferrous metals as a continuation of materials science I
- Non-ferrous metals

Production of metallic materials

- Steel production, steel designations, steel abbreviations
- Aluminium production, designation of aluminium materials
- Copper production, designation of copper materials

Metallic materials

- Carbon steels, heat-treatable steels, nitriding steels, case-hardened steels, rolling bearing steels, tool steels, corrosion-resistant steels
- Copper and aluminium materials

4 Participation requirements

Formal: None
Content: Knowledge from the module "Material Science and Testing 1

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Physics								MBM-2 PHY
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
2.3	**150 h**	**5**	2nd sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students can confidently deal with physical quantities and units. They understand the basic concepts, ideas and mathematical methods of classical physics. They can set up and solve equations of motion for mechanical systems. They understand the creation of images through geometric optics. The students are familiar with the physical basics of the structure of matter. They are able to recognise problem contexts as a prerequisite for solving technical problems. Students possess skills in simple experimentation as well as in the presentation and evaluation of measuring results they are able to prepare protocols for laboratory experiments.

3 Contents

Introduction to the basics of physics:

- The international system of units; conversion of units; scalars and vectors
- Measurement of physical quantities, measurement uncertainty and evaluation of measurement data

Mechanics of mass points and rigid bodies:

- Basic concepts of linear motion; dynamics: Mass, momentum and force; work, energy and power; rotary motion

Geometric optics:

- Light propagation; Reflection and refraction; Optical instruments

Structure of matter:

- Atomic models; molecules; solids

In the supervised self-study, the lecture content is deepened through the application of physical principles using exercise examples. This knowledge is rounded off in the form of a practical course with selected physical experiments from the fields of mechanics and optics. The experiments are carried out and evaluated independently in small groups.

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued attendance certificate for the practical course

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

MBM

8 Module coordinator

Prof. Dr. Frank Hamelmann

9 Other information

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Engineering Mechanics 2 – Mechanics of Materials								MBM-2 TM2
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
2.4	**150 h**	**5**	2nd sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students learn fundamental relationships between the external loads and the resulting internal stresses and deformations.
The students are able to carry out strength checks for simple statically or dynamically stressed components using relevant material parameters.

3 Contents

Introduction:
- Delimitation of topics, conventions

Assessment of failure:
- Static stress
- Oscillating stress on notch-free components
- Stress on notched components

Deformation and thermal stresses
First and second order moments of area, moments of resistance
Internal forces on the beam
Stress types:
- Tensile / compressive stress
- Bending stress
- Torsional stress
- Shear force-induced shear stresses in bending beams
- Buckling stress

Multi-axial stress states and equivalent stresses

4 Participation requirements

Formal: none
Content: Knowledge from the module "Engineering Mechanics – Statics"

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM / ELM

8 Module coordinator

Prof. Dr.-Ing. Daniel Paßmann

9 Other information

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Machine Elements – CAD 2								MBM-2 KE2
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
2.5	**150 h**	**5**	2nd sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are taught about the function and structure of the construction elements as well as their calculation and design. The students are able to explain the function of the presented construction elements, to name advantages and disadvantages of technical alternatives and to design the presented construction elements in general. They can call on their knowledge from the basic subjects, in particular technical documentation, mathematics, physics, mechanics and materials science, in order to find solutions to simple design problems and implement them, taking into account physical, material, technological and economic aspects. The students master the creation of CAD assemblies incl. parts lists. They know the aspects of constructing in a team.

3 Contents

Machine elements:

Connecting elements

- Classification system for connections
- Material connections (welded, soldered, bonded connections)
- Positive-locking connections (rivet, bolt, shaft-hub connections)
- Force-fit connections (press, pin, screw, wedge, single-latch, clamp connections)
- Screw connections

CAD:

- Views and sections
- Drawing derivation and parts lists
- Working with product structure and subassemblies
- kinematic animation of the product

4 Participation requirements

Formal: None

Content: Knowledge from the module “Construction Elements / CAD 1”

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Andreas Tenzler

9 Other information

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Mathematics 3								MBM-3 MA3
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
3.1	**150 h**	**5**	3rd sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are able to describe the motion of a material point as a parameterised path in space, and calculate and draw associated velocity and acceleration vectors. They master the calculation of curve integrals of scalar or vector-valued functions. They are able to classify ordinary differential equations (ODE) and to choose appropriate solution methods. They can confidently solve any linear ODE, as well as non-linear ODEs to which "separation of variables" or substitution methods are applicable. They are well acquainted with initial value problems of *nth* order linear ODE with constant coefficients. They know the typical steps of a modelling (derivation of variables from a physical setup, modelling as ODE, mathematical solution, interpretation of the results) by means of practical examples: "Free fall", "Population biology: logistic growth", "Free & damped oscillations of a spring-mass oscillator". They can solve non-linear ODEs of the type $y^{(n)} = \boldsymbol{f}[x, y^{(n-1)}(x)]$, as well as coupled systems of two linear ODEs of 1st order. Finally, they can use combinatorics and common stochastic techniques such as basic probability calculus, probability trees, and the "hypergeometric distribution" to calculate Laplace probabilities and "conditional probabilities".

3 Contents

Stochastics

- Combinatorics & Laplace Probabilities

Multidimensional integral calculus

- Parameterised paths in space
- Curve integrals of scalar & vector-valued functions

Ordinary differential equations

- Ordinary differential equations of 1st order
- Linear differential equations of *nth*-order with constant coefficients
- Systems of coupled linear DGL 2nd ord. with constant coefficients

4 Participation requirements

Formal: None, requested: Good working knowledge of "Mathematics 1" and "Mathematics 2

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Tilman Hetsch

9 Other information

Participation in the accompanying tutorials is strongly recommended.

Project Management								MBM-3 MPM
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
3.2	**150 h**	**5**	3	Annual	Winter	1 Sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	118 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH / 16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	16 h			40	

2 Learning outcomes / competences

Students know the skills of project management. They recognise projects and can distinguish them from other processes. They know the success and failure factors of a project and can create a project plan with objectives and deliverables as well as monitor the progress of the project itself. The students know the project steering committees and the different roles of the project participants in order to act correctly and effectively with them. They are able to use project management methods and techniques as well as software tools to support their projects.

3 Contents

- Basics of project management
- Stages of project implementation (from preliminary study to project completion)
- Phases of problem solving (analysis, setting of targets, solution formulation)
- Organisation of projects (participants, supporters, incorporation)
- Planning and control of projects (rough and detailed planning, as well as control)
- Leading project groups (behaviour of the project leader, group dynamics, conflict resolution strategies)
- Use of software for project execution
- Techniques of project management

4 Participation requirements

None

5 Form of assessment

Project work or written exam

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Engineering Mechanics 3 – Kinematics and Kinetics								MBM-3 TM3
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
3.3	**150 h**	**5**	3rd sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are taught basic knowledge of the geometric and temporal processes of movements and their interactions with forces and moments in and on mechanical structures.
Students are able to apply the essential basic dynamic laws to points and rigid bodies.

3 Contents

Introduction

- Delimitation of topics, conventions

Kinematics

- Kinematics of the point mass
- Kinematics of rigid bodies

Kinetics

- Kinetics of the point mass, pure translational motion
- Work, energy, power
- Impulse, impulse theorem, law of conservation of momentum for mass points
- Movement of a solid body in a liquid or gaseous medium
- Rotation of a body around a fixed axis
- Work, energy, power for rotary motion
- Impulse moment, impulse moment theorem, impulse moment conservation theorem for rotary motion
- General, plane movement of a rigid body

4 Participation requirements

Formal: none
Content: Knowledge from the module "Engineering Mechanics – Mechanics of Materials"

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM / ELM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Machine Elements – CAD 3								MBM-3 KE3
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
3.4	**150 h**	**5**	3rd sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are taught about the function and structure of the construction elements as well as their calculation and design. The students are able to explain the function of the presented construction elements, to name advantages and disadvantages of technical alternatives and to design the presented construction elements in general. They can call on their knowledge from the basic subjects, in particular technical documentation, mathematics, physics, mechanics and materials science, in order to find solutions to simple design problems and implement them, taking into account physical, material, technological and economic aspects. Students can develop and model their own constructive solutions and document them in accordance with the standards.

3 Contents

Machine elements, design and layout of:

- Axle shafts, springs, couplings
- Traction gear
- Gear drives

CAD:

- Independent parametric part design
- Use of purchased parts and standard parts
- Parametric assembly modelling
- Drawing derivation

4 Participation requirements

Formal: None
Content: Knowledge from the module “Machine Elements – CAD 2”

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Andreas Tenzler

9 Other information

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Electrical Engineering and Electronics								MBM-3 EEG
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
3.5	**150 h**	**5**	3rd sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are familiar with the basic methods of electrical DC and AC technology engineering. They know the fundamentals of complex-valued AC circuit analysis, together with its terminology and can apply it to practical problems. They know electronic circuits with operational amplifiers as used in measurement and control technology. Students are familiar with the basic concepts of electrical power engineering.

3 Contents

Lecture/Exercise

- DC circuits:
  - Basic terms, sources, loads, power, reference arrow systems, basic circuits
  - Induction effects and time-dependent behaviour of capacitors and inductors, flyback diodes
- AC circuits: Basic terms, capacitances, inductances and transformers, pointers, power in AC circuits, complex-valued AC calculation, basic circuits, low and high pass filters, oscillators
- Outlook on electronics: Basic elements, operational amplifiers, outlook digital technology
- Fundamental concepts of electrical power technology: Frequency spectrum, harmonics, three-phase systems

Practical

- Use of measuring instruments in the laboratory
- Examination of linear circuits
- Time-dependent behaviour of capacitances and inductances

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Philipp A. Boysen

9 Other information

-

Project in Industry 1								MBM-4 UP1
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.1	**150 h**	**5**	4th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Work-related project	According to need	150 h	Work-related module	Individual work / faculty tutoring	German, English by agreement

2 Learning outcomes / competences

The students can mirror theoretical references of engineering to fields of application in practice. They can recognise and analyse typical engineering and/or business management problems and independently develop solution options. In the work-related modules, students acquire the ability to connect and reflect on the "world of practice" and the "world of science".

3 Contents

The topics to be worked on are related to engineering and/or business administration and are based on the module contents of the curriculum.
The topic is agreed individually between the student and the faculty tutors in the company and the university.

4 Participation requirements

Formal: None
Content: Knowledge from the module "Project Management"

5 Form of assessment

Term paper

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

All teaching staff

9 Other information

-

Thermodynamics								MBM-4 TTD
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.2	**150 h**	**5**	4th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	118 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	16 h			40	

2 Learning outcomes / competences

The students are taught the thermodynamic and material fundamentals for technical energy conversions and energy transfers as well as the fundamentals for questions of rational energy conversion.

Students are able to

- use physical units safely.
- apply basic thermodynamic concepts safely.
- analyse thermodynamic problems.
- set up and solve mass and energy balances.
- assess energy conversions.
- calculate and evaluate laws for ideal and real fluids.
- solve simple problems of heat transfer.

3 Contents

Thermodynamic basics

- 1st Law of Thermodynamics
- 2nd Law of Thermodynamics
- Reversible changes of state
- Real fluids
- Thermodynamic cycles
- Heat transfer

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

-

<table>
<tr><td colspan="8">Industrial Management</td><td>MBM-4 IBL</td></tr>
<tr><td>No.</td><td>Workload</td><td>Credit points</td><td>Study semester</td><td>Frequency</td><td>Sem.</td><td>Duration</td><td>Type</td><td>Q level</td></tr>
<tr><td>4.3</td><td>150 h</td><td>5</td><td>4th sem.</td><td>Annual</td><td>Summer</td><td>1 sem.</td><td>Compulsory</td><td>BA</td></tr>
<tr><td>1</td><td colspan="2">Course type</td><td>Contact hours</td><td>Self-study</td><td colspan="2">Forms of teaching (forms of learning)</td><td>Planned group size</td><td>Language</td></tr>
<tr><td></td><td colspan="2">Lecture
Exercise
Practical / Seminar
Supervised self-study</td><td>2 SCH
2 SCH/16 h
---
16 h</td><td>118 h</td><td colspan="2">sem. tuition
exercises, case studies
self-study material</td><td>40
40

40</td><td>German</td></tr>
<tr><td>2</td><td colspan="8">Learning outcomes / competences
The students have substantiated knowledge and awareness of the economic thinking and acting of and in industrial companies and can apply this in their studies and practice.
They are able to
• identify and place essential business management aspects, interrelationships, questions and problems within both the economic and engineering context.
• conduct targeted research based on this.
• process business management questions and problems in a methodically adequately.
• communicate appropriately on business topics in an interdisciplinary manner.</td></tr>
<tr><td>3</td><td colspan="8">Contents
Lecture/Exercise/Supervised Self-Study
• Fundamentals of Industrial Enterprises in the Economic System
• Management
• Management Accounting, Controlling
• Industrial Organisation
• Product Development and Marketing
• Production and Logistics</td></tr>
<tr><td>4</td><td colspan="8">Participation requirements
None</td></tr>
<tr><td>5</td><td colspan="8">Form of assessment
Written examination</td></tr>
<tr><td>6</td><td colspan="8">Condition for the award of credit points
Module examination pass</td></tr>
<tr><td>7</td><td colspan="8">Application of the module (in the following study programmes):
MBM</td></tr>
<tr><td>8</td><td colspan="8">Module coordinator
Prof. Dr. rer. pol. Christoph v. Uthmann</td></tr>
<tr><td>9</td><td colspan="8">Other information
-</td></tr>
</table>

Fluid Dynamics								MBM-4 TM4
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.4	**150 h**	**5**	4th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	118 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	16 h			40	

2 Learning outcomes / competences

The students are taught fundamental concepts of fluid mechanics. They will get an overview of the fluid mechanical topics that frequently occur in an engineer's practical work. They are able to calculate pressure forces exerted on bodies and walls by liquids at rest, to calculate flow variables of incompressible flows by applying the law of conservation of energy and to calculate the pressure losses of pipelines carrying liquids. The students know the most important measurement methods used in fluid mechanics.

3 Contents

Physical properties of fluids / hydrostatics:

Definition of pressure, hydrostatic pressure, directional independence of pressure, pressure propagation, communicating vessels, pressure forces on plane & curved walls, hydrostatic pressure.

Basic concepts of fluid dynamics:

Energy equation of steady, frictionless flow, energy equation of ideal fluid (Bernoulli equation), static & dynamic pressure, continuity equation for incompressible and compressible flow, streamline vs. streaklines.

Frictional flow:

Flow forms of real fluids (laminar and turbulent flow) and their properties: flow separation, effect on surface friction, behaviour, technical methods to influence the fluid state.
Fluid flow, pressure loss in pipelines and in pipeline elements
Resistance behaviour of bodies flowing around/force effects in flow processes.

Flow measurement technology:

Pressure measurement, velocity measurement, flow measurement, viscosity measurement

4 Participation requirements

Formal: none

Useful: Some knowledge of "Mathematics 2" (lecture no. 4: multivariable integration, centre of gravity)

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8	**Module coordinator** Prof. Dr.-Ing. Tilman Hetsch
9	**Other information** -

Measurement Technology and Sensors								MBM-4 MSG
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.5	**150 h**	**5**	4th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students have acquired basic knowledge of measurement technology: They understand the physical processes that lead to the measurements as well as the quantities and units of the measured values of the respective process. They have an insight of the sensor principles and measuring chains relevant in process and automation technology. They can classify the sensors on the basis of numerous product examples and assess and plan their use. Students can confidently apply the most important methods of error and compensation calculation. The students know different methods of analogue/digital conversion.

3 Contents

Lecture/Exercise/Supervised Self-Study

- Basics of sensors and measuring systems
- General requirements for sensors and measuring systems
- Error and compensation calculation
- Measurement statistics and error propagation
- Measurement and evaluation of electrical quantities
- Measurement and evaluation of geometric quantities and motion sequences
- Measurement / evaluation of non-electrical physical variables (e.g. temperature)
- Trends in measurement technology (IOT applications)

Internship

- Temperature measurement and statistical evaluation
- Force measurement with bending beam and strain gauges
- Electrical power measurement (current/voltage correct)

4 Participation requirements

Formal: none
Content: Knowledge from the "Electrical Engineering and Electronics" module

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued attestation for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Volker Becker

9 Other information

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Procedures for Design Engineering								MBM-4 KOS
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.6	**150 h**	**5**	4th + 6th sem.	Annual	Summer	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are able to work on a wide range of design and development tasks. Students have knowledge of systematic procedures in design and development. They have the skills to translate this knowledge into constructive outcomes through the use of creativity-enhancing techniques and systematic processes for cost-effective design. The students have developed competences that enable innovative processing of design and development tasks, even of an unknown nature and in new areas.

3 Contents

Introduction to methodical procedures in the design process

Procedure in methodical design:

- Development processes and integration of the development process
- Responsibilities in the product life cycle
- Construction types and order types
- Organisation of development processes
- Task definition
- Function determination, partial functions, functional structures
- Physical effects
- Geometric and kinematic expressions / variations
- Combination of individual solutions
- Evaluation and selection of solutions

4 Participation requirements

None

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Andreas Tenzler

9 Other information

-

Materials Science of Plastics								MBM-4 WDK
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.7	**150 h**	**5**	4th + 6th sem.	Annual	Summer	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students learn the essential structure and the associated structure-property relationships of plastics. They are able to distinguish between the most important thermoplastics and thermosets as well as elastomers and to apply them professionally with regard to their specific properties for suitable component applications.

3 Contents

Introduction to polymer materials
- History, economic importance, classification, processing

Design and structure
- Macromolecules, binding forces, syntheses for production, amorphous / semi-crystalline structure, flow behaviour of melts

Properties of plastics in components
- Thermal-mechanical behaviour, physical / chemical properties, influence of time / temperature / speed

Standard thermoplastics: PE, PP, PET, SAN, PS, PVC, bio-based polymers
Technical thermoplastics: PA, PBT, POM, PMMA, ABS, PC, PPE
High performance thermoplastics: PEEK, PPS, PEI, PES, PSU, PTFE

Fibre-reinforced plastics
- Fibre / matrix systems, laminate structure, fibre volume content, boundary layer

Elastomers
- Rubber, silicones, TPE

Additives and aggregates
- Fillers / reinforcements, antioxidants, stabilisers, flow aids, antistatics, flame retardants, plasticisers

4 Participation requirements

None

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM / ELM

8 Module coordinator

Prof. Dr.-Ing. Daniel Paßmann

9 Other information

-

Manufacturing Processes 1								MBM-4 FV1
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
4.8	**150 h**	**5**	4th + 6th sem.	Annual	Summer	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are given an overview of the various machining processes and their suitability with regard to technical and economic criteria. Students are able to determine the optimum machining process for the product to be manufactured.

3 Contents

Introduction to the Technology of Cutting

- Accuracy requirements
- Designations on the tool
- Movements and forces, cutting geometry

Chip formation, chip shaping and cutting force calculation

- Investigation of chip formation, chip types and shapes
- Cutting force calculation according to Kienzle

Wear and cutting materials

- Causes and forms of wear
- Comparison of different cutting materials, coatings, tool designs

Cooling lubricants

- Tasks and types of cooling lubricating fluids

Choice of economical cutting conditions

- Calculation of production costs

Process with geometrically defined cutting edges
Method with geometrically undefined cutting edges

4 Participation requirements

None

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

-

Project in Industry 2								MBM-5 UP2
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
5.1	**150 h**	**5**	5th sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Work-related project	According to need	150 h	Work-related module	individual work / faculty tutoring	German, by agreement English

2 Learning outcomes / competences

The students can mirror theoretical references of engineering to fields of application in practice. They can recognise and analyse typical engineering and/or business management problems and independently develop solution options. In the work-related modules, students acquire the ability to connect and reflect on the "world of practice" and the "world of science".

3 Contents

The topics to be worked on are related to engineering and/or business administration and are based on the module contents of the curriculum.
The topic is agreed individually between the student and the faculty tutors in the company and the university.

4 Participation requirements

Formal: None
Content: Knowledge from the module "Project Management"

5 Form of assessment

Term paper

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

All teaching staff

9 Other information

-

<table>
<tr><td colspan="8">Technical English</td><td>MBM-5 TEN</td></tr>
<tr><td>No.</td><td>Workload</td><td>Credit points</td><td>Study semester</td><td>Frequency</td><td>Sem.</td><td>Duration</td><td>Type</td><td>Q level</td></tr>
<tr><td>5.2</td><td>150 h</td><td>5</td><td>5th sem.</td><td>Annual</td><td>Winter</td><td>1 sem.</td><td>Compulsory</td><td>BA</td></tr>
<tr><td rowspan="5">1</td><td colspan="2">Course type</td><td>Contact hours</td><td>Self-study</td><td colspan="2">Forms of teaching (forms of learning)</td><td>Planned group size</td><td>Language</td></tr>
<tr><td colspan="2">Lecture</td><td>2 SCH</td><td rowspan="4">118 h</td><td colspan="2" rowspan="4">Seminar lessons with self-study materials</td><td>40</td><td rowspan="4">English</td></tr>
<tr><td colspan="2">Exercise</td><td>2 SCH/16 h</td><td>40</td></tr>
<tr><td colspan="2">Practical / Seminar</td><td>---</td><td>---</td></tr>
<tr><td colspan="2">Supervised self-study</td><td>16 h</td><td>40</td></tr>
<tr><td>2</td><td colspan="8">Learning outcomes / competences
On successful completion of the module, students have the following knowledge and skills:
They can understand and summarise English texts and documents related to mechanical engineering.
They are able to communicate in English with colleagues in conferences on topics related to mechanical engineering.
They can make telephone calls in English.
They can write simple documents in English on topics related to mechanical engineering.
They are able to use English technical vocabulary in their profession.</td></tr>
<tr><td>3</td><td colspan="8">Contents
Overview Engineering, Company and Job Description
Material properties and material stresses
MEMS and nanotechnology
Friction in mechanical engineering
Sustainability
Accident analysis
Wind turbines</td></tr>
<tr><td>4</td><td colspan="8">Participation requirements
None</td></tr>
<tr><td>5</td><td colspan="8">Form of assessment
Written examination</td></tr>
<tr><td>6</td><td colspan="8">Condition for the award of credit points
Module examination pass</td></tr>
<tr><td>7</td><td colspan="8">Application of the module (in the following study programmes):
MBM</td></tr>
<tr><td>8</td><td colspan="8">Module coordinator
Cathrine Stones</td></tr>
<tr><td>9</td><td colspan="8">Other information
-</td></tr>
</table>

Feedback Control Engineering								MBM-5 RTG
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
5.3	**150 h**	**5**	5th sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture,	2 SCH	102 h	Seminar lessons with	40	German
	exercise	1 SCH/12 h		self-study materials	40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students understand the basic terms, ideas and methods of control engineering and know the structure and effect of technical and non-technical control loops. They can analyse real systems, transfer them into technical sketches and diagrams as well as into signal flow graphs and transfer functions. They can identify controlled systems, design standard linear control loops and design simple controllers to match the real systems and simulate the control system.

3 Contents

Lecture/Exercise/Supervised Self-Study

- Classification of technical and non-technical processes
- Description of the static and dynamic behaviour
- Creation of a mathematical model (DGL, transfer function)
- Electrical-physical modelling and simulation
- Properties of elementary transfer elements
- Analysis of control systems in the time and frequency domain
- Requirements for a control loop
- Dimensioning of linear controllers
- Stability definitions and corresponding criteria

Internship

- Structural analysis of oscillatory systems
- Control identification of a thermal system
- Design and realisation of controllers for a thermal system

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued attestation for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Volker Becker

9 Other information

-

Computer Science								MBM-5 INF
No.	**Workload**	**Credit Points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
5.4	**150 h**	**5**	5th sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with self-study materials	40	German
	Exercise	1 SCH/12 h			40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students know the basic principle of computers and can apply simple forms of programming. They know the representation of the fundamental data types of programming languages. They can programme simple tasks in a script language and thus automate work steps on the computer. They also know the basic concept of a database and can create simple data operations and queries.

3 Contents

Lecture/Exercise

- Computer basics
  - Computer architecture
  - Number systems: Decimal, dual and hexadecimal system, and conversion
  - Logical operations
  - Fundamental data types: Integers, characters, string, floating point numbers
- Basics of programming languages
  - Basic elements – variables, branches, loops, subroutines
  - Compiled and script languages
- Algorithms and data structures
  - Algorithms, recursion
  - Flow charts
  - Lists, queues, searches, simple sorting
- Databases
  - Basics, structure, operations / queries

Practical/Project Work

- Algorithmic programming
- Script programming
- Use of databases

4 Participation requirements

None

5 Form of assessment

Performance exam or project work or written exam

6 Condition for the award of credit points

Passed module examination and issued test for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Philipp A. Boysen

9 Other information

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Finite Elements								MBM-5 FEM
No.	**Workload**	**Credit Points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
5.5	**150 h**	**5**	5th + 7th sem.	Annual	Winter	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar-style teaching with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students learn the basics of the operational use of the FE method. They are able to understand the calculation process, its implementation criteria such as load cases and bearing conditions and the evaluation of results. They master the connections between manual calculation, FE method and the critical examination of the results by means of concrete calculation examples of components.

3 Contents

Introduction Simulation Techniques
- Simulation types, task and objective, system theory

Principles of modelling
- System analysis, structural vs. functional model, system types, process of a simulation calculation

The principle of the FEM
- Areas of application, stat. vs. dyn. structural analysis, linear / non-linear behaviour of structure and material

Concrete use of FEA in component development
- Application example, framework conditions, costs, result verification

Essential criteria for implementation
- Nodes, element types, geometry models, meshing, load cases, bearing conditions, calculation sequence, failure criteria

Calculation of a tension rod
- Stresses vs. strains, stress optics, hand calculation vs. computer-aided solution, element stiffness matrix

4 Participation requirements

Formal: None. Content: Knowledge from the modules "Technical Mechanics – Statics / Mechanics of Materials" / "Kinematics and Kinetics" as well as "Machine Elements – CAD 1 to 3"

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Andreas Tenzler

9 Other information

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Plastics Processing								MBM-5 KSV
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
5.6	**150 h**	**5**	5th + 7th sem.	Annual	Winter	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with	40	German
	Exercise	1 SCH/12 h		self-study materials	40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students master the most important manufacturing techniques in plastics processing, both in terms of the processes and the technologies required. The students are able to select a suitable plastics processing method for the production of specific plastic components and semi-finished products and to assess it with regard to the technological variety and suitability.

3 Contents

Structure and composition of polymers (history, production, markets, classification, morphologies) Plastics processing and melt behaviour (overview of manufacturing processes, rheology of plastic melts, PVT behaviour, shrinkage and warpage),
Processing of plastics (conveying, dosing, mixing, drying, plasticising, compounding, granulating, crushing),
Injection moulding and mould (process, plasticising unit, clamping unit, drives, mould technology, melt distribution, equipment procurement),
Extrusion (machine design, single screw/twin screw, extrusion vs. compounding, tool concepts, co-extrusion),
Film blowing, extrusion blow moulding, injection stretch blow moulding (system design, process control, areas of application),
Thermoforming, pressing, processing of curable plastics (vacuum / ram / compressed air, forming / GMT / direct LFT, FRP / SMC processing, vulcanisation rubber),
Welding (ultrasonic, vibration, hot plate, hot gas, laser welding), special processes injection moulding (2K, gas injection, LIM)

4 Participation requirements

Formal: None
Content: Knowledge from the module "Material Science of Plastics"

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Daniel Paßmann

9 Other information

-

Manufacturing Processes 2								MBM-5 FV2
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
5.7	**150 h**	**5**	5th + 7th sem.	Annual	Winter	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are given an overview of metal forming manufacturing processes. They know the necessary metallurgical basics and calculation methods and can apply them to create flow curves and calculate important parameters of forming technology (e.g. degree of forming, speed, forces and stresses). The students are able to distinguish between solid and sheet metal forming processes from the point of view of manufacturable products and to define the advantages and disadvantages of different forming processes from the point of view of manufacturable products. The students know the most important additive manufacturing processes for the production of metallic components.

3 Contents

Definitions of terms and delimitations of procedures
- Cold, semi-hot and hot forming
- Solid and sheet metal forming

Excursion into materials science

Calculations in forming technology
- Flow stress, deformation, forming speed
- Stress states and flow conditions according to Tresca and von Mises
- Friction, forming force and work

Forming process for the manufacture of semi-finished products or components
- Massive forming: Heading, die forging
- Sheet metal forming: Deep drawing, bending

Metal forming machines

Insight into additive manufacturing processes
- Definition, properties, classification, presentation of individual methods

4 Participation requirements

Formal: None; content: Knowledge from the module "Manufacturing Processes 1"

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Project in Industry 3								MBM-6 UP3
No.	**Workload**	**Credit Points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
6.1	**150 h**	**5**	6th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Work-related project	According to need	150 h	Work-related module	Individual work / faculty tutoring	German, by agreement English

2 Learning outcomes / competences

The students can mirror theoretical references of engineering to fields of application in practice. They can recognise and analyse typical engineering and/or business management problems and independently develop solution options. In the work-related modules, students acquire the ability to connect and reflect on the "world of practice" and the "world of science".

3 Contents

The topics to be worked on are related to engineering and/or business administration and are based on the module contents of the curriculum.
The topic is agreed individually between the student and the faculty tutors in the company and the university.

4 Participation requirements

Formal: None
Content: Knowledge from the module " Project Management"

5 Form of assessment

Term paper

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

All teaching staff

9 Other information

-

Control and Automation Technology								MBM-6 SAG
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
6.2	**150 h**	**5**	6th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	102 h	Seminar lessons with	40	German
	Exercise	1 SCH/12 h		self-study materials	40	
	Practical / Seminar	1 SCH/12 h			16	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students are familiar with numerous application examples of automation technology and have internalised the underlying system. They have a sound knowledge of the design and development of automation systems using classic connection programming as well as digital microcontroller and PLC technology and can apply this in automation projects. They can explain the networking of automation components with each other and with control rooms. In sum, the students are thus able to evaluate and design develop basic automation systems.

3 Contents

Lecture/Exercise/Supervised Self-Study

- Automation systems at a glance
- Design and simulation
- Interfaces to the process, sensors and actuators
- Function and structure of programmable logic controllers
- Programming the PLC
- Automation examples
- Buses and peripheral systems
- Process visualisation and modern engineering tools
- Trends in automation systems (real-time capability, networking)

Practical: Taktstraße

- Commissioning of hardware and manual functions, visualisations
- Operating modes and sequencer with sequential process
- Sequencer with parallel processes

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Passed module examination and issued attestation for the practical course

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Volker Becker

9 Other information

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Applied Science Project								MBM-6 PAW
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
6.3	**150 h**	**5**	6th sem.	Annual	Summer	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	118 h	Project	16	German
	Exercise	---				
	Practical / Seminar	2 SCH/32 h			16	
	Supervised self-study	---				

2 Learning outcomes / competences

The students can grasp current and, if necessary, interdisciplinary problems of business administration and/or engineering research and practice, divide them into meaningful sections and solve them. They are able to work in a team and can connect the scientific research approach with the practical world. The students can apply theoretical knowledge already acquired and apply it to concrete problems. They also learn the necessary skills for knowledge transfer within the group.

3 Contents

The content is based on classical or current engineering and/or business topics. The students use the knowledge they have acquired so far in theory and practice and combine the scientific approach with a complex practical task. The topic is decided by the respective subject supervisors and announced at the beginning of the semester.

4 Participation requirements

None

5 Form of assessment

Project work

6 Condition for the award of credit points

Module examination pass

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

Interdisciplinary/cross-curricular use – ELM / MBM / WIM

8 Module coordinator

All teaching staff

9 Other information

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Designing With Plastics								MBM-6 KMK
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
6.4 / 6.5	**150 h**	**5**	6th sem.	Annual	Summer	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with	40	German
	Exercise	2 SCH/16 h		self-study materials	40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

The students can penetrate the basic design and construction guidelines for a design of thermoplastic components suitable for production. They are able to analyse the interactions between material, component design, mould and manufacturing process with a focus on injection moulded components and to adapt their design accordingly. With the help of relevant calculation examples, the design of various component features is learned practically.

3 Contents

Basic aspects of component design (introduction, special features of the material, design systematics, design, FMEA, specifications),
Structure and properties of plastics (classification, stress / strain behaviour, influence of time / temperature / velocity / humidity, dynamic behaviour),
Material- and stress-appropriate design (dimensioning parameters, design against strains / stresses, stress conditions),
Rules for product design (wall thicknesses, corners, edges, conicities, undercuts, free forming),
Geometric stiffeners (ribs, beads, plastic-metal composites),
Joining and connecting techniques (screws / threads, film hinges, clips, inserts / outserts, snap connections, welding, gluing),
Machine elements (plain bearings, rollers, gears),
Component engineering suitable for production (mould filling, weld line, solidification, shrinkage, demoulding, warpage, tolerances),
Requirements of the injection mould (principle, sprue, hot runner, temperature control, ejector)

4 Participation requirements

Formal: None. Content: Knowledge from the modules "Material Science and Testing 1" and "Material Science of Plastics"

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM

8 Module coordinator

Prof. Dr.-Ing. Daniel Paßmann

9 Other information

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Production Planning and Control								MBM-6 FPS
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
6.6	**150 h**	**5**	6th sem.	Annual	Summer	1 sem.	Compulsory elective	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	110 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	24 h			40	

2 Learning outcomes / competences

Students are taught basic knowledge for solving the diverse planning tasks in production and in a production control system.
The students are able to understand the essential tasks of work preparation, as they have become familiar with the tasks and problems of the area of work preparation within the production chain and know various problem-solving methods. They have acquired skills and abilities that enable them to work as engineers in the work preparations of production companies. Work preparation can be seen as a field of work for many engineers working in production areas of companies.

3 Contents

- Tasks of work preparation and its position in companies
- Planning preparation and value analysis/management
- Bill of material and work processing sheet creation
- Programming of production equipment
- Planning of operating resources – Construction of manufacturing resources
- Further planning tasks
  - Cost, test, technical investment, methods and material planning
- Production control
  - Functions of ERP and manufacturing resource planning (MRP II) systems
  - Lead time scheduling and capacity planning

4 Participation requirements

None

5 Form of assessment

Written or performance exam

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr.-Ing. Vanessa Uhlig-Andrae

9 Other information

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Quality Management								MBM-7 QM
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
7.1	**150 h**	**5**	7th sem.	Annual	Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Lecture	2 SCH	118 h	Seminar lessons with self-study materials	40	German
	Exercise	2 SCH/16 h			40	
	Practical / Seminar	---			---	
	Supervised self-study	16 h			40	

2 Learning outcomes / competences

The students have basic and, in selected areas, more in-depth knowledge of quality management in industrial companies and can apply this in their studies and practice. They are able to

- identify essential quality-related aspects, contexts, questions and problems and classify them professionally.
- to conduct targeted research based on this.
- methodically and adequately deal with quality-related questions and problems.
- communicate adequately on quality-related topics in an interdisciplinary manner.

3 Contents

Lecture/Exercise/Supervised Self-Study

- QM basics
  - Understanding, meaning, tasks, principles
  - QM organisation in companies
- QM methods and tools
  - Elementary QM tools
  - QM in product development, production and procurement
- QM systems
  - Reference QM systems (ISO 9000, 6σ, EFQM, ...)
  - Computer Aided QM (CAQ)

4 Participation requirements

None

5 Form of assessment

Written examination

6 Condition for the award of credit points

Module examination pass

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

MBM / WIM

8 Module coordinator

Prof. Dr. rer. pol. Christoph v. Uthmann

9 Other information

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Bachelor Thesis								MBM-7 BAT
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
7.2	**360 h**	**12**	7th sem.		Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Bachelor thesis in a company during the practical training	According to need	360 h	Bachelor thesis	Individual work / faculty tutoring	German, English by agreement

2	**Learning outcomes / competences** With the bachelor thesis, students demonstrate that they are capable of independently working on a practice-oriented task from the respective subject area, both in its subject-specific details and in the interdisciplinary contexts, according to scientific methods within a specified period of time.
3	**Contents** Thesis according to topic. Written elaboration
4	**Participation requirements** See Section 22 SPO MBM
5	**Form of assessment** Bachelor thesis
6	**Condition for the award of credit points** Bachelor thesis pass
7	**Application of the module** (in the following study programmes)**:** MBM
8	**Module coordinator** All teaching staff
9	**Other information** -

Colloquium								MBM-7 BAK
No.	**Workload**	**Credit points**	**Study semester**	**Frequency**	**Sem.**	**Duration**	**Type**	**Q level**
7.3	**90 h**	**3**	7th sem.		Winter	1 sem.	Compulsory	BA

1	**Course type**	**Contact hours**	**Self-study**	**Forms of teaching (forms of learning)**	**Planned group size**	**Language**
	Colloquium	According to need	90 h	Lecture and thesis defence	Individual work / faculty tutoring	German, English by agreement

2	**Learning outcomes / competences**
	The colloquium is to be assessed as an independent examination. It serves to determine whether the candidate is capable of orally presenting and independently justifying the scientific topic of the bachelor thesis, its subject-related foundations, its interdisciplinary connections and its non-subject-related references, as well as assessing its significance for practice.
3	**Contents**
	Content of the thesis according to the topic, Defence of the procedure followed in the preparation of the thesis and questions that arose in the context of the thesis.
4	**Participation requirements**
	See Section 24 SPO MBM
5	**Form of assessment**
	Oral examination
6	**Condition for the award of credit points**
	Module examination pass
7	**Application of the module** (in the following study programmes)**:**
	MBM
8	**Module coordinator**
	All teaching staff
9	**Other information**
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