Course Handbook Mechanical Engineering / Production Technology Bachelor

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Qualifikation Goals of Study Programme

Mechanical Engineering / Production Technology Bachelor - mandatory courses (overview)

Module name (EN)	Code	SAP-P	Academic Year	Clock hours	ECTS	Module coordinator
Core Skill 2	DBMAB-200	P720-0032	2	32US	2	Prof. Dr. Andreas Metz
Design Technology 3	DBMAB-250	P720-0013, P720-0014	2	60UV	5	Prof. Dr.-Ing. Jan Christoph Gaukler
Electrical Engineering	DBMAB-230	P720-0003	2	72UV+12UP	6	Prof. Dr.-Ing. Jan Christoph Gaukler
Engineering Mechanics 3	DBMAB-220	P720-0028	2	48UV+24UU	6	Prof. Dr.-Ing. Jan Christoph Gaukler
Mathematics for Industrial Engineers 1	DBMAB-110	P720-0015	1	40UV+20UU	5	Prof. Dr.-Ing. Jan Christoph Gaukler
Mathematics for Industrial Engineers 2	DBMAB-120	P720-0016	1	40UV+20UU	5	Prof. Dr.-Ing. Jan Christoph Gaukler
Mechatronics and Technical Optics	DBMAB-340	P720-0018, P720-0019	3	76UV+8UU+20US	8	Prof. Dr.-Ing. Jürgen Kohlrusch
Practical Training Module 1	DBMAB-190	P720-0036	1	12US	13	Prof. Dr. Andreas Metz

Module name (EN)	Code	SAP-P	Academic Year	Clock hours	ECTS	Module coordinator
Practical Work	DBMAB-280	P720-0035, S720-0001	2	12US	12	Prof. Dr. Andreas Metz
Production Engineering 1	DBMAB-260	P720-0004	2	80UV	6	Prof. Dr.-Ing. Jan Christoph Gaukler
Scientific Basics	DBMAB-130	P720-0020, P720-0021, P720-0022	1	48UV+32UU+16UP	5	Prof. Dr.-Ing. Jan Christoph Gaukler

(11 modules)

Mechanical Engineering / Production Technology Bachelor - optional courses (overview)

Module name (EN)	Code	SAP-P	Academic Year	Clock hours	ECTS	Module coordinator

(0 modules)

Mechanical Engineering / Production Technology Bachelor - mandatory courses

Core Skill 2

Module name (EN): Core Skill 2
Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021
Module code: DBMAB-200
Hours per semester week / Teaching method: 32US (32 teaching units)
ECTS credits: 2
Academic Year: 2
Mandatory course: yes

Language of instruction:
German

Assessment:
Graded exam (Business English 2: Duration 90 min., 100 pts.)
This exam will be written in the 3rd semester (Block 3B) according to the examination schedule.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBMAB-200 (P720-0032) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 2, mandatory course

Workload:
The total student study time for this course is 60 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Andreas Metz

Lecturer:
Lehrbeauftragte

[*updated 11.11.2025*]

Learning outcomes:
After successfully completing this module, student will, according to their level, be able to follow short or long speeches and simple or complex arguments in standard English, read and understand articles and reports, explain a point of view on a problem, write personal and formal letters and make important points clear.

This module aims at expanding students´ professional competence and, in particular, at strengthening their instrumental and communicative competences.

[*updated 28.04.2023*]

Module content:
The activation, expansion, further development and training of existing English skills and supplementation of these at levels B1 or B2 of the Common European Framework of Reference for Languages; lessons take place in groups that are homogeneous in terms of language skills. Preparation for the Cambridge English: Business Certificates exam from Cambridge Assessment English (Participation in the exam: optional).

[*updated 28.04.2023*]

Teaching methods/Media:
Seminar-style teaching with practical exercises and a high proportion of self-education, class discussions.

[*updated 28.04.2023*]

Recommended or required reading:
Nina O Driscoll, Fiona Scott-Barrett: BEC Vantage Masterclass Course Book, Oxford University Press, ISBN 978-0-19-453197-9
Guy Brook-Hart: Business Benchmark Upper-Intermediate Student s Book (BEC Vantage Edition) Cambridge University Press, ISBN 9783125343139
John Hughes: Success with BEC Vantage, Student s Book, Summertown Publishing, ISBN 9783852728667
Ian Wood, Paul Sanderson, Anne Williams: Pass BEC Vantage. Second Edition, Student s Book, Summertown Publishing, ISBN 9783852728759
Guy Brook-Hart, Norman Whitby: Business Benchmark Pre-Intermediate to Intermediate Second Edition, Student s Book (BEC Preliminary Edition) Cambridge University Press, ISBN 9781107697812
Mara Predetti, Helen Stephenson, Rolf Cook: Success with BEC Preliminary, Student s Book, Summertown Publishing, ISBN: 9783852728636
Ian Wood, Anne Williams, Anna Cowper: Pass BEC Preliminary. Second Edition, Student s Book, Summertown Publishing, ISBN/EAN: 9783852728728

[*updated 28.04.2023*]

Design Technology 3

Module name (EN): Design Technology 3

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-250

Hours per semester week / Teaching method:
60UV (60 teaching units)

ECTS credits:
5

Academic Year: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
2 exams consisting of a graded written examination and a graded term paper
Graded exam (Duration 90 min., 100 pts.)
The exam will be written in the 3rd semester (Block 3B) according to the examination schedule.
Graded term paper (100 pts.)
The topic will be a task related to Machine Elements 2 and 3. It will be handed out on the first working day of the 1st week of Block 4B (4th semester).
The term paper is an exam component comprising 30 hours, to be completed within a period of 60 working days (Mon-Fri except public holidays) from the date on which the topic is issued.

Prerequisites for receiving credits:
The achievement of at least 40 out of 100 points in the module exam.

The achievement of at least 40 out of 100 points for the term paper.

The module grade is calculated as follows:
Exam: 80%
Term paper: 20%

The grade will be shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBMAB-250 (P720-0013, P720-0014) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 2, mandatory course

Workload:
The total student study time for this course is 150 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Lehrbeauftragte

[*updated 11.11.2025*]

Learning outcomes:
After successfully completing this course, students will expand their knowledge of the basic stresses on "buckling and centric buckling". They will be able to assess the stability of equilibrium positions of compression loaded members and determine the critical load for the buckling of members. In addition, they will be able to apply the strength hypotheses to carry out the stress verification for multi-axial loading and dimension the component by comparing the comparative stress and the material parameters. They will be able to determine the appropriate failure hypothesis (ductile and brittle fracture, fatigue fracture, deformation) and select, calculate and design machine elements of rotary motion (axles, shafts, bolts, journals, plain and roller bearings, couplings and brakes) and gears.

Students will be able to work independently and using scientific means on an interdisciplinary task of intermediate complexity (linking technical mechanics, construction and materials technology) for the calculation/dimensioning and design of machine elements.

[*updated 28.04.2023*]

Module content:
Machine elements 2 & 3:
Special strength of materials theory:

o Buckling and centric buckling
o Superimposed stresses (tension/compression, bending, torsion and buckling) and applying the strength hypotheses
o Strength verification regarding failures due to ductile and brittle fractures, due to fatigue fractures and due to deformations
o More detailed information on failure due to fatigue fractures Wöhler curve, low cycle fatigue, high cycle fatigue, very high cycle fatigue, load profile, fatigue strength diagram according to Haigh and Smith

Machine elements of rotating motion
o Axles, shafts, bolts and pins: types, design and calculation
o Plain and rolling bearings: types, design, selection, installation, tolerances, bearing clearance, lubrication, rolling element pairs and Hertzian pressure, dimensioning (static/dynamic), calculation of service life
o Clutches (shiftable, non-shiftable) and brakes: types, functionality and selection

Gearboxes:
o Gears: geometry, law of gearing, involute gearing
o Gear and belt drives

[*updated 28.04.2023*]

Teaching methods/Media:
Lecture: Lecture, demonstrations, question and impulse teaching
Exercises: Demonstrations, question and impulse teaching, working on specific problems
Term paper: Independent work on a specific problem

[*updated 28.04.2023*]

Recommended or required reading:
D. Gross, W. Hauger, J. Schröder, W. A. Wall: Technische Mechanik 2 Elastostatik (Springer)
R. C. Hibbeler: Technische Mechanik 2 Festigkeitslehre (Pearson)
D. Gross, W. Hauger, P. Wriggers: Technische Mechanik 4
H. Wittel, D. Jannasch, J. Voßlek, Ch. Spura: Roloff/Matek Maschinenelemente, Springer Vieweg Verlag
K.H. Decker, Maschinenelemente, Carl Hanser Verlag
B. Künne: Köhler/Rögnitz, Maschinenteile 1+2, Springer Vieweg
H. Habenhauer, F. Bodenstein: Maschinenelemente, Springer-Verlag

[*updated 28.04.2023*]

Electrical Engineering

Module name (EN): Electrical Engineering

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-230

Hours per semester week / Teaching method:
72UV+12UP (84 teaching units)

ECTS credits:
6

Academic Year: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Graded exam (Duration 150 min., 100 pts.)
o The exam will be written in the 4th semester (Block 4A) according to the examination schedule.
o Distribution
- 70 pts. (105 min) on "Fundamentals of Electrical Engineering" and the associated laboratory exercises
- 30 pts. (45 min) on "Electric Drive Systems" and the corresponding laboratory exercises

Prerequisites for receiving credits:
The achievement of at least 40 out of 100 points in the module exam.
The grade corresponds to the student s performance in the module exam and is shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBING-220 (P750-0014) Integrated Sustainable Building Technology, Bachelor, SO 01.10.2024 , study year 2, mandatory course
DBMAB-230 (P720-0003) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 2, mandatory course
DBMAB-230 (P720-0003) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2024 , study year 2, mandatory course

Workload:
The total student study time for this course is 180 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
DBMAB-340 Mechatronics and Technical Optics

[*updated 11.11.2025*]

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Lehrbeauftragte

[*updated 11.11.2025*]

Learning outcomes:
After successfully completing this module, students will be familiar with the basic laws and physical relationships of electrical engineering and have mastered their application in mechanical engineering and production technology. They will be able to classify and evaluate the analogies between mechanics and

electrical engineering as well as the economic significance of electrical engineering in a superordinate context. Students will be able to design, draw and calculate simple electrotechnical circuits independently and choose between electrotechnical and mechanical solutions according to technical and economic aspects, or to complement solutions from both areas in a meaningful way. They will be familiar with the principles and methods for measuring electrical and non-electrical quantities and will be able to apply them. Students will be able to understand basic correlations in electrical engineering processes and select and apply adequate problem solving methods.

They will be able to name electrical machines and their components and analyze the operating behavior of electrical machines based on given data in order to calculate selected variables and characteristic curves. In doing so, they will use the usual equivalent circuit diagrams and graphical methods.

They will have a good command of the terms, symbols and language used in electrical engineering in order to be able to communicate in an interdisciplinary team with electrical engineers, among others.

[*updated 28.04.2023*]

Module content:

Fundamentals of Electrical Engineering:
Electric field with quantities and methods:
charge, current, current density, potential, voltage, field strength, force on charge carriers,
Ohm´s law, resistance, conductance, electric circuit, source voltage, voltage drop, power,
electric displacement flow, capacitance, EMC
Magnetic field with quantities and methods: magnetic poles, source-free fields, right-hand rule,
magnetic flux, induction flow-through, field strength, flow-through law, magnetic voltage, magnetic
resistance, permeability, magnetic field constant, hysteresis, Lorentz force, induction law, generator,
self-induction, counter-induction, inductance, transformer, eddy currents, energies and forces in magnetic field,
passive components
Calculating circuits with direct current:
Kirchhoff´s laws, basic circuits, short circuit, open circuit, adaptation, energy and
power, efficiency, non-linear resistances, graphical determination of operating point, resistance networks,
meshed networks, systematic network analysis using the node and mesh method
Calculating circuits for alternating current:
Generating alternating current with an electrical machine, time average, effective value, passive sign convention,
voltage and current at capacitance and inductance, series circuits with
alternating current, pointer diagrams, parallel circuits with alternating current, complex pointer in
in alternating current technology, complex representation of resistances and conductance values with alternating current, active power,
reactive power, apparent power, series and parallel resonant circuits, reactive power compensation.
Three-phase electric power (three-phase current):
connected three-phase system, power in the three-phase system, star/delta switching, neutral conductor currents,
frequent cases of asymmetrical faults

Electric drive systems:
Torque generation, electrical and mechanical power, rotary field generation and torque generation in
three-phase machines
DC machines:
design, mode of operation, armature reaction, equivalent circuit, characteristic curve, generator and motor operation,
speed setting, special designs, speed control

Three-phase asynchronous machine:
Design, operating principle, equivalent circuit, vector diagrams, characteristic curve, current locus curve, current displacement rotor, Three-phase asynchronous machine on
frequency inverter
Synchronous machine:
design, rotor designs, excitation devices, equivalent circuit, vector diagrams, characteristic curve, current locus curves
DC and three-phase motors on single-phase alternating current

Electrical engineering laboratory:
The Elektrotechnisches Labor (Electrical Engineering Laboratory) component provides practical training and enables the application of the knowledge acquired in the lectures by means of the following tests/exercises/experiments: Unloaded and loaded voltage divider, bridge circuit using the deflection method, filter circuit (RC low-pass filter), series resonant circuit, symmetrical and asymmetrical loading of a three-phase system (star circuit), three-phase asynchronous machine controlled by means of a frequency converter, recording a characteristic curve on a slip ring motor, fan control (bridge circuit with temperature-dependent resistor, threshold switch and transistor switch).

[*updated 28.04.2023*]

Teaching methods/Media:
Lecture: Lecture, demonstration, group work on concrete problems
Labs: Learning and experiencing scientific and technical interrelationships by means of experiments carried out in groups

[*updated 28.04.2023*]

Recommended or required reading:
R. Busch: Elektrotechnik für Maschinenbauer und Verfahrenstechniker, Teubner Verlag
R. Fischer, H. Linse: Elektrotechnik für Maschinenbauer, Teubner Verlag
E. Hering, R. Martin, J. Gutekunst, J. Kempkes: Elektrotechnik und Elektronik für Maschinenbauer, Springer Verlag
G. Flegel, K. Birnstiel, W. Nerreter: Elektrotechnik für Maschinenbau und Mechatronik, Hanser-Verlag.
G. Hagmann: Grundlagen der Elektrotechnik, Aula Verlag.

[*updated 28.04.2023*]

Engineering Mechanics 3

Module name (EN): Engineering Mechanics 3

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-220

Hours per semester week / Teaching method:
48UV+24UU (72 teaching units)

ECTS credits:
6

Academic Year: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Graded exam (Duration 120 min., 100 pts.)
o This exam will be written in the 3rd semester (Block 3B) according to the examination schedule.
o Distribution
- 67 pts. (80 min) for Dynamik-1 (Dynamics 1)
- 33 pts. (40 min) for Dynamik-2 (Dynamics 2)

Prerequisites for receiving credits:
The achievement of at least 40 out of 100 points in the module exam.
The grade corresponds to the student s performance in the module exam and is shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBMAB-220 (P720-0028) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 2, mandatory course

Workload:
The total student study time for this course is 180 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Lehrbeauftragte

[*updated 11.11.2025*]

Learning outcomes:
After successfully completing this module, students will have consolidated, deepened and expanded their understanding of mechanical relationships with regard to the description and calculation of the spatial motion of point masses and rigid bodies and collision processes . They will be able to describe and calculate vibrations of machine parts. They will be able to analyze engineering problems of intermediate complexity in the field of dynamics, to reduce them to basic physical principles and work out targeted solutions, so that they can design and dimension moving machines or machines with moving elements.

[*updated 28.04.2023*]

Module content:
Dynamik-1 (Dynamics 1):
Review of the dynamics of a mass point
Kinetics of a system of mass points - consolidation
o Center of mass theorem, Varignon s theorem, principle of work and energy
o Centric collision
o Bodies with variable mass

Motion of a rigid body
o Kinematic basics: Translation, rotation, general motion, instantaneous center
o Kinetics of rotation around a fixed axis: Varignon´s theorem, moment of inertia, work, energy, power
o Planar kinetics: Varignon´s theorem, momentum, principles of energy and work, eccentric collision
o Kinetics of spatial motion: Varignon´s theorem, angular momentum, inertia tensor, Euler´s equations, bearing reactions in plane motion, momentum-free gyro

Dynamics 2:
Free oscillations (undamped, damped) with one degree of freedom
Forced oscillations (undamped, damped) with one degree of freedom Force and mass force excitation, magnification function, resonance
Examples of vibrations of machine parts from practice
Free oscillations in systems with two and more degrees of freedom
Forced oscillations in systems with two and more degrees of freedom Resonance, damping, apparent resonance

[*updated 28.04.2023*]

Teaching methods/Media:
Lecture: Lecture, demonstration, working on specific problems in groups.
Exercises: Solving specific problems in groups

[*updated 28.04.2023*]

Recommended or required reading:
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3: Kinetik (Springer)
R. C. Hibbeler: Technische Mechanik 3 Dynamik (Pearson)
H. Dresig, F. Holzweißig: Maschinendynamik, Springer-Verlag
M. Knaebel, H. Jäger, R. Mastel: Technische Schwingungslehre, Springer Vieweg

[*updated 28.04.2023*]

Mathematics for Industrial Engineers 1

Module name (EN): Mathematics for Industrial Engineers 1

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-110

Hours per semester week / Teaching method:
40UV+20UU (60 teaching units)

ECTS credits:
5

Academic Year: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Graded exam (Mathematics 1: Duration 120 min., 100 pts.)
This exam will be written in the 1st semester (Block 1B) according to the examination schedule.

Prerequisites for receiving credits:
Achievement of at least 40 out of 100 points in the "Mathematics 1" exam.
The module grade corresponds to the student s performance in the "Mathematics 1" exam and is shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBING-110 (P750-0003) Integrated Sustainable Building Technology, Bachelor, SO 01.10.2024 , study year 1, mandatory course
DBMAB-110 (P720-0015) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 1, mandatory course

Workload:
The total student study time for this course is 150 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
DBMAB-120 Mathematics for Industrial Engineers 2

[*updated 11.11.2025*]

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Lehrbeauftragte

[*updated 11.11.2025*]

Learning outcomes:

After successfully completing this module, students will be able to apply mathematical calculation techniques to individual mathematical problems. We will also look at examples of applications in physics and technology. Students understand the concepts of limit and continuity. They will be familiar with the basics of differential calculus and be able to apply derivative rules to functions in one variable. Students will

be able to use the rule of Bernoulli and de l Hôpital to calculate limits. They will understand the basic principles of integral calculus and be able to use integration techniques to integrate functions in one variable. In addition, students will be familiar with the field of ordinary differential equations and be able to apply it to first order linear differential equations with constant coefficients.

[*updated 28.04.2023*]

Module content:

- Function, limits, calculation rules for limits, continuity of a function
  Differential calculus: Basics, derivation rules, applications of differential calculus (monotonicity of functions, curvature of a plane curve, extreme values, points of inflection, Bernoulli and de l Hôpital s rule, kinematics)
  Integral calculus in a variable: indefinite integral, definite integral, fundamental theorem of differential and integral calculus, integration techniques, application examples
- Ordinary differential equations: first order linear differential equations with constant coefficients, examples of application

[*updated 28.04.2023*]

Teaching methods/Media:
Lecture: Lecture, demonstration, group work on concrete problems
Exercises: Group work on concrete problems

[*updated 28.04.2023*]

Recommended or required reading:

L. Papula: Mathematik für Ingenieure und Naturwissenschaftler Band 1, Springer Vieweg Wiesbaden
L. Papula: Mathematik für Ingenieure und Naturwissenschaftler Band 2, Springer Vieweg Wiesbaden

[*updated 28.04.2023*]

Mathematics for Industrial Engineers 2

Module name (EN): Mathematics for Industrial Engineers 2

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-120

Hours per semester week / Teaching method:
40UV+20UU (60 teaching units)

ECTS credits:
5

Academic Year: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Graded exam (Mathematics 2: Duration 120 min., 100 pts.)
This exam will be written in the 2nd semester (Block 2A) according to the examination schedule.

Prerequisites for receiving credits:
The achievement of at least 40 out of 100 points in the "Mathematics 2" exam.
The module grade corresponds to the student s performance in the "Mathematics 2" exam and is shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBING-120 (P750-0002) Integrated Sustainable Building Technology, Bachelor, SO 01.10.2024 , study year 1, mandatory course
DBMAB-120 (P720-0016) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 1, mandatory course

Workload:
The total student study time for this course is 150 hours.

Recommended prerequisites (modules):
DBMAB-110 Mathematics for Industrial Engineers 1

[*updated 11.11.2025*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Lehrbeauftragte

[*updated 11.11.2025*]

Learning outcomes:

After successfully completing this module, students will be familiar with mathematical computational techniques and be able to apply them to individual mathematical problems. These calculation techniques will also be applied to examples from physics and technology. Students will be able to apply second-order linear differential equations in vibration theory. They will be able to apply the chain rule in forming partial derivatives of functions in several variables and calculate partial derivatives - even for implicit functions. Students will have mastered the arithmetic operations of matrices and be able to apply arithmetic rules for determinants. They will be able to solve linear systems of equations according to the Gaussian algorithm.

[*updated 28.04.2023*]

Module content:

Second-order linear differential equations and their application in vibration theory
Functions in several variables: partial derivative, partial and complete differential, chain rule, derivative of implicit functions, extrema
Matrices and determinants: Matrices, arithmetic operations with matrices, rank of a matrix, inverse matrix, determinants, arithmetic rules for determinants
Linear systems of equations and the Gaussian algorithm

[*updated 28.04.2023*]

Teaching methods/Media:
Lecture: Lecture, demonstration, group work on concrete problems
Exercises: Group work on concrete problems

[*updated 28.04.2023*]

Recommended or required reading:

L. Papula: Mathematik für Ingenieure und Naturwissenschaftler Band 1, Springer Vieweg Wiesbaden
L. Papula: Mathematik für Ingenieure und Naturwissenschaftler Band 2, Springer Vieweg Wiesbaden

[*updated 28.04.2023*]

Mechatronics and Technical Optics

Module name (EN): Mechatronics and Technical Optics

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-340

Hours per semester week / Teaching method:
76UV+8UU+20US (104 teaching units, accumulated)

ECTS credits:
8

Academic Year: 3

Duration: 2 semester

Mandatory course: yes

Language of instruction:
German

Assessment:
2 graded exams:
Exam 1 (Applied Metrology und Control Eingineering, Duration 120 min., 100 pts.)

o The exam will be written in the 5th semester (Block 5A) according to the exam schedule.
o Distribution
- 50 pts. (60 min) for Angewandter Messtechnik (Applied Metrology)
- 50 pts. (60 min) for Regelungstechnik (Control Eingineering)

Partial exam (Angewandte Mechatronik und Technische Optik (Applied Mechatronics and Technical Optics): Duration 90 min., 100 pts.)
o This exam will be written in the 6th semester (Block 6A) according to the examination schedule.
o Distribution
- 50 pts. (45 min.) for Angewandter Mechatronik (Applied Mechatronics)
- 50 pts. (45 min.) for Technische Optik (Technical Optics)

Reasons for splitting the exam into two partial exams:
The Angewandte Messtechnik and Regelungstechnik lectures in block 5A (5th semester) are the prerequisites with regard to content for the "Angewandte Mechatronik" lecture in block 6A (6th semester).
The workload for Angewandte Mechatronik is calculated on the assumption that the contents and methods taught in the lectures Angewandte Messtechnik and Regelungstechnik can be understood and applied, i.e. Angewandte Mechatronik requires the competencies acquired in the lectures Angewandte Messtechnik and Regelungstechnik .
- The division into two exams, one written in Block 5A (5th semester) and the other in Block 6A (6th semester), ensures that the workload is evenly distributed.

Prerequisites for receiving credits:
The achievement of at least 40 points out of 100 in each partial exam.

The module grade is calculated as follows:
62.5% of the points for the "Angewandte Messtechnik & Regelungstechnik exam
37.5% of the points for the Angewandte Mechatronik & Technische Optik exam
The grade will be shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBMAB-340 (P720-0018, P720-0019) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 3, mandatory course

Workload:
The total student study time for this course is 240 hours.

Recommended prerequisites (modules):
DBMAB-130 Scientific Basics
DBMAB-230 Electrical Engineering

[*updated 11.11.2025*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jürgen Kohlrusch

Lecturer:
Prof. Dr.-Ing. Jan Christoph Gaukler (seminar (units))
Lehrbeauftragte (lecture (units))

[*updated 11.11.2025*]

Learning outcomes:
Angewandte Messtechnik (Applied Metrology):
After successfully completing this part of the module, students will be familiar with basic metrological and sensory principles and will be able to use and evaluate sensors for measuring physical quantities such as displacement, angle, force, pressure, acceleration, angular velocity, flow and temperature.

Regelungstechnik (Control Eingineering):
After successfully completing this part of the module, students will be familiar with the basic components of a closed control loop and be able to explain and, if necessary, identify control engineering terms such as command variable, control difference or control variable. They will be able to analyze simple dynamic control systems in the time and frequency domain and understand test signals such as the step function, the impulse function or the Dirac delta distribution.

Angewandte Mechatronik (Applied Mechatronics):
After successfully completing this part of the module, students will be familiar with the expansion of mechanical systems by way of sensors, microcomputers and actuators for the realization of semi-intelligent products and systems. They will understand the function and construction of mechatronic systems and be able to assess and evaluate their areas of use in various applications such as automotive, aerospace technology or production technology. Building on the knowledge acquired in the sub-modules "Angewandte Messtechnik" and "Regelungstechnik", "Angewandte Mechatronik" will expand students´ knowledge of the use of microcomputers and, in particular, different types of actuators. With this knowledge, students will be able to develop mechatronic systems into cyber-physical systems in the Industrie 4.0 module.

Technische Optik (Technical Optics):
After successfully completing this part of the module, students will be familiar with the basics of optics and in particular geometrical optics. They will be familiar with the most important optical processes and devices and understand how they work. In addition, they will be able to construct basic optical systems.

[*updated 28.04.2023*]

Module content:
Angewandte Messtechnik (Applied Metrology):
Metrological principles
- o Basic units
- o Carrying out measurements, measurement uncertainty, deviations and accuracy
- o Calibration of measuring devices
- o Error propagation

Sensor basics
- o Basics
- o Measurement chain
- o Instrumental uncertainty
- o Signal transmission behavior
- o Measurement strategy

Sensors for measuring physical quantities
- o Path and angle
- o Force und pressure
- o Acceleration and angular velocity
- o Flow rate
- o Temperature

Regelungstechnik (Control Eingineering):
Basics of control engineering
- o Control engineering systems task definition
- o Control loop, dynamic systems
- o Block diagram according to DIN EN 60027-6
- o Linear systems in the time and frequency domain, Laplace transformation
- o Working with the Bode plot

Test signals
- o Step function
- o Pulse function
- o Dirac delta function
- o Broadband noise

Individual elements of controlled systems
- o Proportional term (P)
- o Integrator (I)
- o DT1 transfer function (DT1)
- o 2nd order time delay - PT2 transfer function (PT2)

Angewandte Mechatronik (Applied Mechatronics):
Design and functionality of mechatronic systems
- o Examples of applications
- o Sensor connection, analogue/digital converter, Nyquist-Shannon sampling theorem
- o Microcomputer design
- o Digital/analogue converter, auxiliary power for actuators

Actuators
- o Electromechanical actuators
- o Electric motors, small and micromotors
- o Piezoelectric actuators
- o Fluid mechanical actuators (hydraulics, pneumatics)
- o Thermomechanical actuators
- o Adaptronics

Technische Optik (Technical Optics):
Review of basic optical terms
- o Fermat s principle
- o Polarization by absorption, scattering, reflection and birefringence
- o Electromagnetic waves in general and in matter

Geometrical optics
- o Plane mirror, virtual image, pixel
- o Spherical mirrors, real image, spherical aberration, image distance, object distance and focal distance, imaging equation, concave and convex mirrors, image construction, imaging scale
- o Image formation through refraction
- o Lenses: thin lenses, midplane, virtual object, imaging equation, biconvex/biconcave lenses, focal points, focal plane, image construction, thick lenses, multiple lenses in series, refractive power, aberration

o Optical instruments

[*updated 28.04.2023*]

Teaching methods/Media:
Lectures: Lecture, demonstrations, question and impulse teaching, working on concrete problems in groups
Seminar: Lecture, demonstrations, question and impulse teaching, Self-development and self-experience in scientific contexts by means of partner work,
tests and experiments

[*updated 28.04.2023*]

Recommended or required reading:
J. Hoffmann: Taschenbuch der Messtechnik (Fachbuchverlag Leipzig)
J. Hoffmann: Handbuch der Messtechnik (Carl Hanser Verlag)
R. Isermann: Mechatronische Systeme Grundlagen (Springer)
M. Reuter, S. Zacher: Regelungstechnik für Ingenieure Analyse, Simulation und Entwurf von Regelkreisen (Vieweg + Teubner Verlag)
S. Zacher: Übungsbuch Regelungstechnik Klassische, modell- und wissensbasierte Verfahren (Vieweg + Teubner Verlag)
J. Lunze: Regelungstechnik 1 Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen (Springer)
O. Fröllinger: Regelungstechnik Einführung in die Methoden und ihre Anwendung (Hüthig)
U. Mescheder: Mikrosystemtechnik (Springer Vieweg)
F. Pedrotti, L. Pedrotti, W. Bausch, H. Schmidt: Optik für Ingenieure (Springer)
D. Kühlke: Optik Grundlagen und Anwendungen (Harri)
J. Bliedtner, G. Gräfe: Optiktechnologie: Grundlagen Verfahren Anwendungen Beispiele (Hanser)

[*updated 28.04.2023*]

Practical Training Module 1

Module name (EN): Practical Training Module 1

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-190

Hours per semester week / Teaching method:
12US (12 teaching units, accumulated)

ECTS credits:
13

Academic Year: 1

Duration: 2 semester

Mandatory course: yes

Language of instruction:
German

Assessment:
Non-graded course credit in accordance with the requirements for poster presentations after the first practical module at the ASW in "Technik" (Technology).
The poster presentation will take place at the end of block 2B (2nd semester; mid/end of August) as part of the seminar Professionelles Präsentieren (Professional Presentations).

Prerequisites for receiving credits:
Passing the above-mentioned academic achievement (= passed grade from the examination board)

[*updated 08.04.2025*]

Applicability / Curricular relevance:

DBMAB-190 (P720-0036) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 1, mandatory course
DBWI-190 (P740-0016) Industrial Engineering / Production Management, Bachelor, ASPO 01.10.2022 , study year 1, mandatory course
DBWI-190 (P740-0016) Industrial Engineering / Production Management, Bachelor, ASPO 01.10.2021 , study year 1, mandatory course

Workload:
The total student study time for this course is 390 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Andreas Metz

Lecturer:
Lehrbeauftragte (seminar (units))

[*updated 11.11.2025*]

Learning outcomes:
Professional Presentations:
This seminar is part of the academic supervision provided by the study director.
Students will have mastered the basics of presentation techniques. They will be able to prepare and develop presentations in a systematic and targeted manner.
They will be familiar with the main forms of presentation (speaking freely, or holding a talk with slides or screen presentation support) and will be able to use these in their own presentations. In addition, they will be able to integrate things such as product demonstrations or films into their presentations in an appropriate manner. In addition, they will be able to describe and understand technical problems from operational practice in a written paper (poster presentation).

Practical phase (= practical professional activities):
As part of their practical work, students will gain first insights into applying the basics from their field of study in operational practice. Under instruction:
They can describe narrowly defined problems according to predetermined principles, continue their learning processes in a narrowly defined area and acquire up-to-date knowledge. In subject areas with which they are

familiar, students will be able to apply various fundamental methods and procedures on their own. Furthermore, students will be familiar with the basic processes in their respective companies and will be able to present these appropriately. In this module, students will thus apply their knowledge to their professional activities for the first time and thus, be able to this knowledge to include practical issues and skills.

The aim of practical module 1 is to expand and strengthen instrumental skills and to develop systemic skills in collecting, evaluating and interpreting relevant information, as well as in independently designing further learning processes.

[*updated 08.04.2025*]

Module content:
Seminar: Professional Presentations:

Basics of presentation techniques,
Setting goals and monitoring success,
Systematic preparation of a presentation (target group analysis, technical preparation, risk analysis),
Logical structure and dramaturgy of a presentation,
Resources and how to use them
Alternative presentation forms

Practical work experience in the resp. company:

This part of the dual study program gives students an understanding of industrial practice by providing them with basic practical skills (including manual skills) in departments with the following focus: design engineering, manufacturing technology (molding, forming, cutting, joining, coating, changing material properties), plastics technology, quality assurance, materials testing, damage analysis, assembly and maintenance.

[*updated 08.04.2025*]

Teaching methods/Media:
Seminar: Stimulated and question-based teaching, demonstrations in individual, partner and group work, classroom discussion
Practical phase: Practical work in the company providing the training (developed) in individual, partner and/or group work

[*updated 08.04.2025*]

Recommended or required reading:

[*updated 08.04.2025*]

Practical Work

Module name (EN): Practical Work

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-280

Hours per semester week / Teaching method:
12US (12 teaching units)

ECTS credits:
12

Academic Year: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
- Written practical work (graded)
  o The topic is an operational, production engineering problem. It will be handed out on the first working day of the 1st week of Block 4B (4th semester).
  o The practical work module comprises 240-hours which are to be completed within a period of 60 working days (Mon-Fri excluding public holidays) from the date on which resp. the topic was assigned to the student.

(Graded) presentation of the practical work
o The presentation (PowerPoint presentation) will be held during the Wissenschaftliches Arbeiten (Scientific Work) seminar in the last three weeks of Block 4B (4th semester; mid/end of August).

Prerequisites for receiving credits:
Practical work graded as at least ausreichend
Presentation graded as at least ausreichend

The module grade is calculated as follows:
67% of the points for the practical work
33% of the points for the presentation

The grade will be shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBMAB-280 (P720-0035, S720-0001) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 2, mandatory course

Workload:
The total student study time for this course is 360 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Andreas Metz

Lecturer:
Prof. Dr.-Ing. Jürgen Kohlrusch

[*updated 11.11.2025*]

Learning outcomes:
Scientific Work:
This seminar is part of the academic supervision provided by the study director.

After successfully completing this module, students will be able to use clear criteria to determine the topic of a scientific paper, define the problem and objective, develop an appropriate approach, and complete and document the scientific paper within a given time frame. They will be familiar with how to approach a scientific paper with methodological confidence and know the evaluation criteria.

Students will be able to present their practical work in the context of a scientific seminar presentation, in which the essential facts about the problem, the state of knowledge, the procedure (including project planning), the implementation and evaluation and the most important conclusions including the outlook are discussed and presented. In the ensuing scientific discussion, students will be able to demonstrate that they can defend subject-related positions and solutions to problems in an argumentative manner and exchange ideas with engineers and other scientists about their project work.

Practical work (= practical professional activities):
The practical work in Block 4B (4th semester) is designed to prepare students for working independently on larger problems and tasks using scientific methods, including the associated discussions. It consists of experiment protocols, homework, a practical module 1 (with the "Professionelles Präsentieren seminar), a practical project (with project work and the "Project Management seminar), practical work (with the "Scientific Work seminar), the practical module 2 and the Bachelor´s thesis.

Students will improve their instrumental expertise by applying the knowledge they have acquired thus far from various subject areas to a larger practical project of moderate complexity in the area of mechanical engineering with a focus on production technology. They will demonstrate that they are capable of developing or improving solutions to technical problems by applying scientific methods with little guidance. Students will be proficient in analyzing problem situations and choosing appropriate methods to solve problems. They will be able to present their approach and results appropriately.

This practical work aims at building instrumental expertise in the sense of the application of knowledge and understanding. This module aims at building systemic competence, in particular by gathering, evaluating and interpreting relevant information in the context of the practical project. Communicative skills are strengthened by the fact that students must work in a team within their respective company and take responsibility for the work they did there, and by the fact that they must defend their project work in a discussion and exchange ideas with engineers and other scientists.

[*updated 28.04.2023*]

Module content:
Wissenschaftliches Arbeiten (Scientific Work):
- Fundamentals of the philosophy of science, terminology
- Requirements for scientific work
- Reasoning (inductive, deductive reasoning)
- Formulating a topic for a scientific paper
- Time management
- Documentation, citation methods
- Use of EDP, handling large files, format templates,
- Footnotes etc. in a common word processing system

Creating graphics
Saving data
Presenting your practical work and taking part in a subsequent scientific discussion

Practical work:
In Block 4B (4th semester), students will work on a specific, operational problem or project totaling 240 hours, which they will solve or develop further over a period of 60 working days using scientific methods with a minimum of guidance from an appropriately qualified, operational supervisor. The topic of the practical work is proposed by the company and examined, approved and assigned by the Head of Studies. As documented evidence, the student will prepare a 25 to 30-page written paper that includes his/her task problem, the state of knowledge, the approach taken (including project planning), the implementation including evaluation, and the students conclusions including an outlook.

[*updated 28.04.2023*]

Teaching methods/Media:
Seminar: Impulse and question teaching, demonstrations in individual, partner and group work, class discussions, scientific discussions
Career: Practical work experience in the resp. company

[*updated 28.04.2023*]

Recommended or required reading:

[*updated 28.04.2023*]

Production Engineering 1

Module name (EN): Production Engineering 1

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-260

Hours per semester week / Teaching method:
80UV (80 teaching units, accumulated)

ECTS credits:
6

Academic Year: 2

Duration: 2 semester

Mandatory course: yes

Language of instruction:
German

Assessment:

Graded exam (Production Engineering 1: Duration 120 min., 100 pts.)
The exam will be written in the 4th semester (Block 4A) according to the examination schedule.

Prerequisites for receiving credits:
The achievement of at least 40 out of 100 points in the module exam.
The grade corresponds to the student s performance in the module exam and is shown as a decimal grade according to the htw saar grading scheme.

[*updated 28.04.2023*]

Applicability / Curricular relevance:

DBMAB-260 (P720-0004) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 2, mandatory course

Workload:
The total student study time for this course is 180 hours.

Recommended prerequisites (modules):
DBMAB-130 Scientific Basics
DBMAB-160

[*updated 11.11.2025*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Prof. Dr.-Ing. Jan Christoph Gaukler

[*updated 11.11.2025*]

Learning outcomes:
After successfully completing this module, students will be able to classify manufacturing technologies in the context of production technology, know their interfaces to product development, design technology, materials technology and quality management and will be familiar with the basics of manufacturing accuracy. They will be able to take a holistic view of complex and networked production chains for the manufacture of mechanical engineering products and understand the more in-depth and advanced fundamentals of materials technology with regard to the structure and properties of metals (in particular casting defects in alloys, solidification morphology, castability, plastomechanics [introduction], machinability). They will be able to explain how the production processes of primary moulding work and what they can be used for (continuous casting, sand casting, gravity and low-pressure die casting, pressure die casting, centrifugal casting, electroforming, powder technology),
reshaping (massive forming, sheet metal forming, near-net-shape component production), near-net-shape component production (thixoforging, powder and sinter forging, hydroforming and superplastic forming) and cutting (esp. chiseling, filing, sawing, turning, sinking, milling, broaching, grinding, honing, lapping). They will be able to select suitable processes and identify and establish their main manufacturing parameters.

This knowledge will enable them to analyze manufacturing problems, evaluate the technical and economic

suitability of metals and manufacturing processes for the production of new products, and select the best manufacturing route (possibly consisting of several manufacturing steps) in terms of product properties and costs. Furthermore, they will be able to recognize and solve simple problems in the conceptual design and establishment of this manufacturing route. Students will also be able to evaluate established manufacturing routes and justifiably demonstrate alternatives for improving product properties or saving costs.

[*updated 28.04.2023*]

Module content:

Introduction to production engineering

o Industrial production engineering, tasks and interrelationships of production engineering, the product development process, classification of production processes

o Manufacturing accuracy: true value, correct value, empirical value, selection of suitable production processes based on order data, geometry, technology and time values, factors influencing accuracy, Quality requirements and assurance, quality-oriented production, production metrology, defects (systematic, random), recording measured valuse, dimensional, form and positional accuracy, surface quality, shape deviation, roughness parameters, achievable roughness of production processes, functional and machine accuracy taking into account static, dynamic and thermal disturbances, tribological tool changes

o Complex 21st century manufacturing chains: interlinking metallurgy, materials and production engineering, Overview of metallurgical processes for the production of crude metal, production of used metal by way of primary processing (ingot casting, continuous casting) and forming (rolling, forging, extrusion), followed by further production processes for the production of the finished component, practical examples.

The technology of primary processing

o Definition, classification and process overview

o Fundamentals of materials engineering: solidification of pure metals and of alloys, casting defects in pure metals and alloys, technological influence on solidification, solidification morphology, castability, metallic casting materials.

o Guidelines for designing castings that are suitable for the casting process

o Smelting technology: tasks and mode of operation of cupola, induction, electric arc, rotary drum, resistance and electron beam furnaces.

o Foundry operation technology: continuous casting, sand casting, gravity and low-pressure die casting, pressure die casting, centrifugal casting

o Electroforming: functionality, production equipment, tools, products

o Powder technology: production route, process overview, powder production (atomising, rotary atomising), shaping (spray compacting, injection moulding (including Metal Injection Moulding; MIM)), pressing, powder and sinter forging), sintering (definition, classification, sintering processes).

Forming technology

o Definition, semi-finished product production, workpiece production, advantages of forming

o Fundamentals of materials engineering:

- Plastic behavior: Cold and hot forming
- Introduction to plastomechanics: Stress and distortion state, stress tensor (deviatoric and hydrostatic component), flow conditions (shear stress theory according to Tresca, maximum shear strain energy criterion according to von Mises), flow rule, effective strain, effective strain rate, determining the flow curve, Ludwik

equation for unalloyed and low-alloy steels as well as Al alloys

- Deep-drawing steels: Requirements, alloy concepts, production routes, mechanical properties
- Friction: Real material surface, factors influencing friction, laws of friction, wear, lubricants (requirements, composition, effect)

o Massive forming: Rolling (process variations, flat longitudinal rolling of plates), forging (die forming, free forming), extrusion (direct, indirect, hydrostatic), wire drawing, upsetting, impact extrusion

o Sheet metal forming: Deep-drawing with tools, hydromechanical deep-drawing, electromagnetic forming, stretch-forming

- Near-net-shape manufacturing
o Additive production
- Process variants, materials, technology, advantages, applications
- Procedures: Selective laser sintering, 3D printing, stereolithography
o Thixoforging
o Internal high-pressure forming
o Superplastic forming

Cutting technology (Part I)
o Machining processses
- Definition, classification, process overview, productivity and quality
- Basics of machining processes: Mechanisms of the cutting process and chip formation, cutting and chip sizes in drilling and turning, geometry of the cutting edge, chip types, built-up edge, chip volume ratio and class, influence of cutting speed, depth of cut, feed rate and tool geometry on the chip shape, chip grooves on tools, heat generation during machining and distribution of heat to cooling lubricant, chip, workpiece and tool, tool life, sizes, conditions and criteria, cutting processes with geometrically-defined cutting edge

- Machining process with geometrically-defined cutting edge: chiseling, sawing, filing, turning, drilling, countersinking, reaming, milling, broaching

- Machining process with geometrically indeterminate cutting edge: grinding, honing, lapping
- Machinability: cutting materials, machining behavior of metallic materials, free-machining alloys (alloy concept, structure, properties), high-speed cutting, cooling lubricants

[*updated 28.04.2023*]

Teaching methods/Media:
Lecture: Lecture, demonstrations, question and impulse teaching, working on concrete problems in groups, work on case studies

[*updated 28.04.2023*]

Recommended or required reading:
W. Bergmann: Werkstofftechnik 1 (Carl Haser Verlag)
W. Bergmann: Werkstofftechnik 2 (Carl Haser Verlag)
F. Klocke: Fertigungsverfahren 1 Drehen, Fräsen und Bohren, Springer Vieweg

F. Klocke: Fertigungsverfahren 2 Zerspanen mit geometrisch unbestimmter Schneide, Springer Vieweg
W. König: Fertigungsverfahren 3 Abtragen, Generieren und Lasermaterialbearbeitung, Springer Vieweg
F. Klocke: Fertigungsverfahren 4 Umformen, Springer Vieweg
F. Klocke: Fertigungsverfahren 5 Gießen und Pulvermetallurgie, Springer Vieweg
D. Gross, W. Hauger, J. Schröder, W. A. Wall: Technische Mechanik 2 Elastostatik (Springer)
D. Gross, W. Hauger, P. Wriggers: Technische Mechanik 4

[*updated 28.04.2023*]

Scientific Basics

Module name (EN): Scientific Basics

Degree programme: Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021

Module code: DBMAB-130

Hours per semester week / Teaching method:
48UV+32UU+16UP (96 teaching units)

ECTS credits:
5

Academic Year: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 120 min.

[*updated 29.08.2025*]

Applicability / Curricular relevance:

DBING-130 (P750-0004, P750-0005, P750-0006) Integrated Sustainable Building Technology, Bachelor, SO 01.10.2024 , study year 1, mandatory course
DBMAB-130 (P720-0020, P720-0021, P720-0022) Mechanical Engineering / Production Technology, Bachelor, ASPO 01.10.2021 , study year 1, mandatory course
DBWI-130 (P740-0005, P740-0006, P740-0007) Industrial Engineering / Production Management, Bachelor, ASPO 01.10.2022 , study year 1, mandatory course
DBWI-130 (P740-0005, P740-0006, P740-0007) Industrial Engineering / Production Management, Bachelor, ASPO 01.10.2021 , study year 1, mandatory course

Workload:
The total student study time for this course is 150 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
DBMAB-240
DBMAB-260 Production Engineering 1
DBMAB-310
DBMAB-320
DBMAB-340 Mechatronics and Technical Optics

[*updated 11.11.2025*]

Module coordinator:
Prof. Dr.-Ing. Jan Christoph Gaukler

Lecturer:
Prof. Dr.-Ing. Jan Christoph Gaukler

[*updated 11.11.2025*]

Learning outcomes:
Basic Chemistry:

After successfully completing this module, students will be familiar with the essential basics of general chemistry, including atomic structure, the periodic table of elements, chemical bonding, states of matter, chemical reactions and chemical thermodynamics. They will understand the connection between the electron configuration of the atoms, the structure of the periodic table and the properties of the elements derived from it. They will be able to describe the chemical bonding of substances, prepare molecular formulas and, in the case of covalently bonded substances, also structural formulas, and derive structure-property relationships. Students will be familiar with the basic principles of chemical reactions (reaction equation, stoichiometry, equilibrium, redox and acid-base reactions) and can apply them in order to interpret simple chemical processes. This includes the use of simple, chemical calculations. Students will be familiar with the basic principles of chemical thermodynamics (thermochemistry, chemical reaction processes, catalysts, and inhibitors) and chemical reaction kinetics and will be able to apply this knowledge to interpret and calculate simple chemical processes.

Experimental Physics:

Students will be familiar with the scientific principles of the dynamics of a single point mass and systems of point masses. They will be familiar with the basic terms, phenomena and concepts and understand the physical relationships. This knowledge will enable students to reduce simple engineering problems to basic physical principles or questions, to answer these physical questions independently using mathematical methods, and thus, find a solution to the actual engineering problem in a targeted manner.

Chemistry Lab:

They will be able to set up and perform basic chemical experiments. Based on observations and existing knowledge, they will be able to derive conclusions and link them to the contents of the "General Chemistry" lecture. In addition, students will also be able to write lab reports/experiment reports.

Physics Lab:

By means of experiments, students will independently study the essential physical principles of the

mechanics of rigid and real (liquids, gases) bodies, as well as waves, optics, atomic and quantum physics. They will be able to set up basic, physical experiments, carry out series of experiments and measurements and evaluate them, taking into account the calculation of errors. In addition, they will be able to draw conclusions after critically evaluating measurement results and to prepare laboratory reports/test reports.

[*updated 29.08.2025*]

Module content:
Basic Chemistry:

Atomic structure and the periodic system of elements: Classical elementary particles, structure of atoms, isotopes, orbital model, electron configuration, structure of the periodic table
Chemical Bonding:: Ionic bonding, covalent bonding, metallic bonding, dispersion, induction, and dipole-dipole interactions, hydrogen bonding, structure-property relationships
States of Matter: (ideal gases, Boyle´s, Gay-Lussac´s, and Avogadro´s laws, ideal gas equation), liquids, crystalline and amorphous solids, structural principles of ideal crystals, coordination number, Bravais lattice, metallic lattice structures, packing density, Miller indices, lattice vacancies and their significance for alloy formation)
Homogeneous mixtures (gas mixtures and Dalton´s law, solutions, single-phase alloys), heterogeneous mixtures
Chemical Reactions: Reaction equations and stoichiometry, equilibrium, redox and acid-base reactions, chemical thermodynamics (reaction heat, energy and enthalpy, enthalpy of formation, Hess´s law, reaction entropy, chemical reaction sequences, free enthalpy, catalysis (homogeneous, heterogeneous))

Experimental Physics:

Units of measurement, measuring physical quantities and calculating errors
Mechanics of point masses: One- and multidimensional motion, average velocity, instantaneous velocity, average acceleration, instantaneous acceleration, velocity-time and distance-time laws, free fall, projectile motion, uniform circular motion, angular velocity, centripetal and centrifugal acceleration, Newton´s axioms, momentum, gravitational, spring, normal, and frictional forces, air resistance, work and power in conservative and non-conservative force fields, kinetic energy, potential energy of gravity near the Earth´s surface and in general, spring energy, total energy of a mass point, conservation of energy, superimposed force fields
Mechanics of a system of mass points: Center of mass, velocity, acceleration, force, momentum and conservation of momentum, systems with variable mass (thrust force and velocity of a rocket; basic rocket equation), impact processes (conservation of momentum, energy and angular momentum, types of impact [elastic, inelastic, superelastic], elasticity number)

Chemistry Lab:
Laboratory and safety regulations
Experiments on acid-base reactions, buffer systems, quantitative determination (titration), electrochemistry, and redox chemistry
Qualitative and quantitative analysis of water (ion detection, hardness determination)

Physics Lab:
Unit of measurement, measuring physical quantities and calculating errors
Experiments in mechanics and optics
Experiments in atomic and quantum physics

[*updated 29.08.2025*]

Teaching methods/Media:
Lectures: Presentation, work on specific problems in groups
Exercises: Group work on concrete problems
Labs: Self-study and hands-on experience with scientific concepts through partner work involving experiments.

[*updated 29.08.2025*]

Recommended or required reading:
J. Hoinkis, E. Lindner: Chemie für Ingenieure (Wiley-VCH)
P. W. Atkins, J. de Paula: Physikalische Chemie (Wiley-VCH)
P. A. Tipler, G. Mosca: Physik für Wissenschaftlicher und Ingenieure (Springer)
D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3: Kinetik (Springer)
R. C. Hibbeler: Technische Mechanik 3 Dynamik (Pearson)

[*updated 28.04.2023*]

Mechanical Engineering / Production Technology Bachelor - optional courses