BACHELOR
ENGINEERING AND MANAGEMENT
Courses are taught in German unless it is specifically stated that the language of instruction is English.

Table of Contents

BACHELOR ........................................................................................................................................... 0
ENGINEERING AND MANAGEMENT ........................................................................................................ 0
1. Compulsory Modules in the 1st Semester ................................................................. 2
2. Compulsory Modules in the 2nd Semester ............................................................. 8
3. Compulsory Modules in the 3rd Semester ........................................................... 15
4. Compulsory Modules in the 4th Semester ............................................................ 21
5. Compulsory Modules in the 5th Semester .......................................................... 26
6. Compulsory Modules in the 6th Semester ............................................................ 31
7. Compulsory Modules in the 7th Semester ............................................................ 35
8. Subject-Specific Modules ...................................................................................... 39
   8.1 Industrial Engineering ...................................................................................... 39
   8.2 Information Technology .................................................................................. 45
   8.3 Bio & Environmental Technology .................................................................. 51
9. Compulsory Elective Modules ................................................................................ 57
1. Compulsory Modules in the 1st Semester

Mathematics I

Learning objectives / competencies:

The overall objective of the course is for students to acquire important skills in scientific computing in technical and economic disciplines.

By the end of the course students will:

- Be confident in using the most basic mathematical functions graphically.
- Have an understanding of curves in Cartesian and polar coordinates.
- Have mastered differential calculus for the above mentioned functions and function types.
- Know how to approximate functions using polynomials and be able to solve simple extreme value problems.
- Have an understanding of functions that depend on several variables.
- Be able to partially differentiate and know how to transfer the derivatives of functions of one variable to functions of several variables.
- Know the basic primitives and have mastered the most important principles and techniques of integral calculus.
- Have mastered arithmetic with vectors and understood the geometric ideas behind various mathematical operations.
- Have a clear idea of scalar and vector fields and have mastered differential calculus in relation to these.

In particular, students will learn about the typical applications of the topics mentioned above.

Course content:

- Functions and curves
- Differential calculus for functions of one variable
- Taylor expansion
- Differential calculus for functions of several variables
- Integral calculus
- Vector algebra and vector analysis
Engineering Mechanics

Learning objectives / competencies:

By the end of the course students will:

- Be aware of the forces and moments in simple solid-state systems.
- Know how to determine forces and moments in mounting points and the impact of forces on substructures.
- Understand friction situations in technology.
- Be able to calculate the barycentre of bodies.
- Be able to determine the internal forces of subsystems (stresses) and their impact (strains).
- Understand the variables that influence static and dynamic component strength.
- Be able to demonstrate the strength of components in linear and simple compounded strain cases.

Course content:

- Summary of forces to resultants
- Bearing of bodies and application of the cutting principle
- Systems in balance
- Coulomb static and dynamic friction
- Relationship between stress and strain on material law
- Effects of traction/strain, bending, shear and torsion
- Practical application of the strength of materials: static and dynamic strength analysis of components
Chemistry and Materials

Learning objectives / competencies:

Technical Chemistry

By the end of the course students will:

- Know the atomic structure of substances.
- Understand stoichiometric relationships and be able to perform simple calculations.
- Understand equilibrium reactions and electrochemical processes and their influence.
- Know the basic organic substances and reaction types.
- Understand the basics of thermodynamics.

Introduction to Materials Science

By the end of the course students will:

- Understand the importance of and working areas in materials technology.
- Know the main material groups and be able to cite examples of them.
- Understand the preparation, properties and applications of ceramic and polymeric materials.

Course content:

- Technical chemistry
- Atomic structure and periodic system
- Chemical bonds
- Chemical equilibria
- Electrochemistry
- Basics of organic chemistry
- Introduction to materials science
- Technical ceramics
- Polymeric materials
Technical Drawing

Learning objectives / competencies:
By the end of the course students will:

- Be familiar with the technical norms for drawings.
- Be able to represent the body in three-dimensional views.
- Understand the principles behind toleration of component measures, shape and position tolerances and the ISO fitting system.
- Understand the relationship between required quality and costs.
- Be able to create simple technical drawings independently and manually for the manufacturing and assembly of products, mainly in mechanical engineering.
- Be able to create simple BOMs.
- Be able to identify the function of illustrated devices, groups of machines and machines in general in assembly drawings.

Course content:

- Basis norms for technical drawings
- The three panel projection
- Measurement registrations and principles of toleration
- The ISO fitting system and data of surface qualities
- Representation of standardized components
Business Administration

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the economic aspects of specific topics in the current business press.
- Have learnt about the relevant relationships between businesses and the environment in terms of making corporate management decisions.
- Understand the key business processes and operational functions of service provision and utilization.
- Understand the functions of operational cooperation within a company and cross-functional management.

Course content:

- Constitutive decisions (choice of legal form of the company and site, cooperation and concentration forms).
- Corporate activities and business indicators (productivity, efficiency, profitability, liquidity).
- Business processes and basic functions of operational service provision and utilization.
- Management and cooperation of value added processes in the circulation of macroeconomic goods and money.
- Defining market and corporate developments.
Basics of Computer Science

Learning objectives / competencies:

By the end of the course students will:

- Have learnt the methods used in engineering-based problem solving.
- Be able to solve simple technical and economic problems using algorithms.
- Know how to program using basic imperative programming language.

Course content:

- Solving engineering-based problems in technology and economics by programming in a modern programming language or in a programming-related way.
- Basics of data processing to establish a comparable level of knowledge regarding the current state of development in computer science and information technology.
- VBA programming with Microsoft Office as an introduction to programming and the VB programming development environment.
- Declaring variables and constants.
- Basic and structured data types in Visual Basic.
- Basic in/output and print output programming.
- Elementary arithmetic using Visual Basic.
- Testing and failure analysis, the VB debugger, documentation.
- Basic principles of structured programming, creation of simple structure charts.
- Programming of control structures in Visual Basic.
- Programming subroutines in Visual Basic.
- Introduction to object-oriented programming with Visual Basic by creating a simple graphical user interface.
- File handling in VB.
- Introduction to number systems and coding, the binary system, hexadecimal representation and basic computer arithmetic.
- The application of VB in specific subject areas in technology and economics.
2. Compulsory Modules in the 2nd Semester

Mathematics II

Learning objectives / competencies:
By the end of the course students will:

- Be able to solve linear equations systematically and have mastered the basic techniques of arithmetic with matrices.
- Be able to use complex numbers in the different display options confidently and understand the difference between real and complex functions.
- Know how to interpret a double or a triple integral, solve them computationally in Cartesian and polar coordinates and be able to describe integration areas in the above mentioned coordinate systems.
- Be familiar with the tools used to visualize the solution behaviour of ordinary differential equations, know how to assign them to their respective class and be able to solve them using the relevant procedures.
- Understand the principle of integral transformation and know how to use the Laplace and Fourier transformations in appropriate application areas.

In particular, students will learn about the typical applications of the topics mentioned above.

Course content:

- Matrices and linear systems of equations
- Complex numbers and functions
- Integral calculus for functions of several variables
- Differential equations
- Laplace transformation
- Fourier transformation
Physics

Learning objectives / competencies:

By the end of the course students will:

- Understand the importance of physics as the scientific basis for the work of engineers.
- Know the basic laws of physics and have the ability to proof technical applications in terms of physical laws.
- Have an understanding of physical-technical issues, such as problem identification, problem formulation by applying the basic laws of physics, translation into mathematical language.
- Be able to problem solve using calculations.

Course content:

- Mechanics: kinematics and dynamics of particles and rigid bodies
- Thermodynamics: state quantities and changes of state of ideal and real gases
Material Engineering

Learning objectives / competencies:

By the end of the course students will:

- Understand the structure of metallic materials and the significance of errors in their structure.
- Understand the mechanisms of elastic and plastic deformation and recognize the importance of the influence of deformation properties on metals.
- Understand the mechanisms that lead to the equalization of concentration differences and understand the changes of state when adding alloying elements.
- Know the basics of manufacturing metallic materials in construction.
- Understand the properties of iron-based materials, light metals and copper-based materials and know about their essential applications.
- Be able to influence the properties of materials by applying suitable and thermal treatments.
- Be familiar with the most important selection criteria for materials.

Course content:

- Lattice structure and lattice defects
- Deformation behaviour
- Diffusion
- Recovery and recrystallization
- Iron-based materials
- Light metals
- Copper and its alloys
Electrical Engineering

Learning objectives / competencies:

By the end of the course students will:

- Understand the principles behind electro technology in the fields of direct current, electrostatics, electromagnetism and alternating current.
- Be familiar with the significant technological applications of basic electrical engineering.
- Have learnt the basics of analog signal processing (amplification, filtering, mathematical processing, modulation).
- Understand the basics of digital technology in terms of information representation and processing and its technical realization (AD/DA transformation, compression).
- Have learnt how to deal with industrial simulation methods.

Course content:

- Direct current: simple electric circuits, network analysis, equivalent voltage sources.
- Electrostatics and electromagnetism: physical principles, capacitance and inductance, Faraday’s law, motors and generators, transformers.
- Alternating current: calculation methodology, applications (modulation, spectral analysis).
- Semiconductor technology and signal processing: transistors, operational amplifiers, filtering.
- Digital technology: digitalization, digital signal processing.
- Internship with industry standard software.
Machine Elements

Learning objectives / competencies:

By the end of the course students will:

- Understand the advantages and disadvantages of various joining techniques.
- Know the structural constraints of different joining techniques.
- Be able to identify the basic operation of parts or assemblies from technical drawings and be able to infer the mechanical model from them.
- Be able to calculate and interpret different compounds and machine elements using simple formulas.
- Be familiar with different shaft-hub connectors, their properties and design principles.

Course content:

- Features of detachable connectors such as screws, pins, rivets
- Features of non-releasable connectors such as welding, soldering, gluing
- Calculation methods for different joining techniques
- Shaft-hub connectors
Financial Accounting

Learning objectives / competencies:

By the end of the course students will:

- Understand the basic principles and procedures of accounting.
- Be able to record business transactions for an industrial company.
- Be able to assess how the balance changes according to entrepreneurial activity.
- Know how to record balance sheet assets and liabilities in accordance with German and the international law.
- Be able to calculate the number of the balance sheet items in accordance with German and the international law.
- Be able to compile the profit and loss statement.

Course content:

- Basics of accounting
- Accounting according to German law
- Accounting according to international law
Economics

Learning objectives / competencies:

By the end of the course students will:

- Have acquired the necessary knowledge to understand macroeconomic contexts.
- Understand the link between the political economy and business administration in order to comprehend the economic consequences of corporate activities.
- Appreciate the operational consequences of macroeconomic developments and economic policy decisions.

Course content:

- Performance of the market: how do markets work and why are they effective?
- Pricing in different markets: how to develop optimal business strategies.
- Competition and competition barriers: economy policy methods to ensure competition.
- Growth and employment: theoretical considerations, current trends and economic policies.
- International economics: theory of foreign trade, presentation and analysis of external economic interlacing.
3. Compulsory Modules in the 3rd Semester

Production

Learning objectives / competencies:
By the end of the course students will:

- Have learnt the basics of the industrial manufacturing of work pieces
- Have understood the main groups of manufacturing engineering.
- Be familiar with the important manufacturing processes of the main groups: forming, transforming, separating, joining and coating.
- Know the typical machines and tools used for various processes.
- Understand the interplay of quality and costs in the relative manufacturing process and which consequences are relevant to each process.
- Be able to perform basic calculations for the most important manufacturing processes.

Course content:

- Distinction production – manufacturing engineering
- Main groups of manufacturing engineering
- Selected manufacturing processes
Applied Technology

Learning objectives / competencies:

By the end of the course students will:

- Be able to perform ordinary laboratory experiments, record and evaluate measured data and present their results and interpretations in a written document that is as professional as a scientific publication.
- Be able to explain physical and technical matters and applications in a structured and clear way as part of a lecture.
- Be familiar with the most important testing procedures for destructing and non-destructing materials.
- Be able to choose suitable material testing procedures and know how to classify material properties.
- Be familiar with the characteristics of complex machine elements.
- Be able to make basic decisions about how to use complex machine elements from a technical and scientific point of view.
- Be able to estimate sizes and dimensions of machine elements using simple formulas.

Course content:

- Training in physics
  - Mechanics: kinematics and dynamics of particles and rigid bodies.
  - Thermodynamics: state quantities and changes of state of ideal and real gases.
- Technical project: materials testing
  - The course is offered in cooperation with an industrial company or an institute or laboratory.
  - Destructive testing such as tensile testing of plastics and metals, beam impact testing, fracture surface analysis.
  - Investigation to determine the hardenability of steels, including metallography.
  - Non-destructive testing of materials.
- Complex machine elements
  - Spring systems, sliding and rolling bearings, switchable and non-switchable clutches, gear transmission and traction drives.
  - Vibration behaviour of machines.
Cost Accounting

Learning objectives / competencies:

By the end of the course students will:

- Be able to transfer expenditures from bookkeeping into costs.
- Be able to perform internal cost allocations with the correct procedures.
- Have learnt how to calculate the cost of a product with the correct calculation method depending on the type of production.
- Know how profit can change according to specific decisions.
- Recognize the shortcomings of traditional cost accounting and be able to remedy them.

Course content:

- Cost type accounting
- Cost centre accounting
- Cost unit accounting
- Marginal costing
- Activity accounting
- Planned cost calculation
Data Analysis

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the statistical methods that are important for industrial engineers.
- Be able to apply these techniques confidently to example records in the fields of economics and technology.
- Understand that damage can be caused by the incorrect use of statistical methods (correlation versus causation, risk to the whole model, opportunities for manipulation).

Course content:

- Measures of descriptive statistics
- Analysis of frequencies
- Graphical representations
- Exploratory data analysis
- Discrete and continuous distributions
- Significance tests (chi-square, Kolmogorov/Smirnov)
- Confidence intervals and statistical content areas
- Comparison of data sets
- Correlation and regression (including multiple)
- Statistical process control and capability
- Weibull analysis
Information Systems

Learning objectives / competencies:

By the end of the course students will:

- Be aware of the modern operational use of information systems and current information technologies.
- Have basic knowledge of how computers, operating systems, network technologies and databases function.
- Know the methods for selecting and implementing complex information systems for technical and commercial use.
- Have learnt the methods of IT project implementation using a simple example.

Course content:

Students will be given a basic overview of the information technologies currently used in companies (e.g. computers, operating systems, network/internet technology and databases). They will also learn about current information systems and how they support modern business processes. In a case study on software introduction, students will discuss about how to create advanced custom software and how to evaluate standard software. Furthermore, they will learn how to choose the right software and put it to use with good acceptance.

For students taking the “Information Technology” pathway this course will be closely linked to the IT project. The tasks and activities in the course and the project will be synchronized as much as possible.

Examples of possible course content:

- Architecture and infrastructure components of modern integrated information systems.
- Standard software versus custom software - make or buy alternatives.
- Process models for the creation of information systems.
- Introduction to UML
- Integrated location software systems, ERP systems, workflow.
- Examples of modern information systems in technical and commercial use (office systems, document management systems, CAD and other technical information systems).
- Database technology in operational use and the basics of data modelling.
- An overview of modern information technology to build communication infrastructures.
- Network technology in general.
- Basic Internet technologies (HTML, XML, FTP, email)
- eBusiness in operational use - functional and technical requirements and their current solutions.
• Case study: evaluation of an integrated solution for information system requirements, creation of a requirement-specification document.
• Methods for basic project management of IT projects.
4. Compulsory Modules in the 4th Semester

Automation and Sensor Systems

Learning objectives / competencies:
By the end of the course students will:

- Be familiar with the systems and components that are essential to the automation of measurement processes.
- Have learnt about the physical and electro-technical backgrounds.
- Know how to assess the dependencies and interactions of automation components.

Course content:

- Physical principles of sensors:
  - atoms, waves and particles, radioactivity
  - electromagnetic radiation
  - ray optics, wave optics, quantum optics
  - semiconductors: basic physics, technology, devices
  - embodiments and applications of sensors in industrial instrumentation, automotive, optical communications technology, biotechnology, medicine
- Basics of electrical metrology
- Signal processing and transmission
- Measurement error: error types and propagation
- Measurement systems
- Basic control technology, PLC
- 2-point control
Marketing
(Taught in English)

Learning objectives / competencies:

By the end of the course students will:

- Understand the basics of marketing for investment goods and durable consumer goods.
- Be familiar with the requirements of and procedures for the segmentation of markets and positioning of products.
- Recognize the interrelationships in the integrated product lifecycle.
- Understand the impact of technology management and marketing on a company's success.
- Appreciate the strategic context of and background to marketing decisions in the real market.
- Be able to use the knowledge they have acquired in case studies and project work.

Course content:

- Principles of marketing
- Segmentation and positioning
- Procedure for market research
- Integrated product lifecycle
- Products as a mix of technologies
- The first/follower problem
Finance and Investment Management
(Taught in German and English)

Learning objectives / competencies:
By the end of the course students will:

- Understand the basics of investing and finance.
- Have learnt about the tools used in financial and investment controlling.
- Be familiar with funding instruments.
- Recognize the influence of investment and finance on business success.
- Be able to show the context of and background to financial decisions with practical examples.

Course content:

- Basics of finance and investment management
- Companies as bundles of cash flows
- Financial mathematic applications
- Analysis of annual reports and corporate figures
- Investment calculation methods
- Instruments to raise capital
- Financial and risk policies
Business Language Options:

Business Language: English I

Learning objectives / competencies:
By the end of the course students will:

- Have developed comprehensive language communication skills.
- Expanded their knowledge of technical terminology and be familiar with the most important professional activities.
- Have acquired knowledge and expertise in the field of Business English.

Course content:

- Improving communicative skills in a vocational context.

Business Language: French I

Learning objectives / competencies:
By the end of the course students will:

- Have developed comprehensive foreign language communication skills.
- Expanded their knowledge of technical terminology for the most important professional activities.
- Have acquired basic skills in the commercial, cultural and social language characteristics of French-speaking countries.

Course content:

- Business communication
- Corporate and commercial basics
Ergonomics with Practical Training
(Taught in German and English)

Learning objectives / competencies:

By the end of the course students will:

- Have learnt the principles behind and methodological approaches to human factors and ergonomics.
- Know the basics of human performance and motivation as well as their considerations in the design of workplaces, organization, work equipment and the production environment.

Course content:

- Ergonomics: conceptual, legal, lawful, economic and social.
- Performance requirements of humans (physical condition, skills, disposition and motivation).
- Tasks, objectives and principles of ergonomic job design.
- Design examples of industrial workplaces and equipment.
5. Compulsory Modules in the 5th Semester

Production Management and Logistics I

Learning objectives / competencies:

By the end of the course students will:

- Understand the basics of technical operational management such as work plans, bills of materials, time plans, etc.
- Understand the importance of how to estimate numbers of demand in order to draft a flexible production plan.
- Be familiar with the types of organization and performance of production.
- Be aware of the different forms of production control.

Course content:

- Production management
- Production planning
- Production logistics
Business Planning and Organisation

Learning objectives / competencies:

By the end of the course students will:

- Know about the different procedures and methods of strategic and tactical operational planning in the different life stages of a company.
- Understand different design models of an organization (organizational structure, process and projects)
- Be able to select appropriate methods and procedures to solve problems.

Course content:

- Strategic planning and designing of business concepts, long-term objectives, resources (financial and expertise), product-market concept, SWOT analysis, derivation of the performance strategy.
- Organizational strategy to obtain the structure of an organization, including the creation of jobs and hierarchies.
- Capacity dimensioning, derived business and investment plan preparation, the problem of uncertainty in all components of strategic planning and design.
- Implementation of performance and organizational strategies with project management, the interface of strategic planning and budget planning, the problem of adjusting the annual budget during the current year.
- Management of priority conflicts and crisis situations in the current business (lean management, reengineering, rationalization, innovation management).
- Feedback systems using metrics and balanced scorecards.
Project Planning and Quality Management

Learning objectives / competencies:

By the end of the course students will:

- Know about the basic relationships in project management.
- Be familiar with the essential concepts, approaches and methods of project development: preparation, planning, procurement, monitoring and controlling.
- Recognize the relationships between project management and other functional areas.
- Recognize the influence of cross-cultural, leadership and behavioural factors on project success.
- Be able to analyse and create appropriate solutions for typical project situations.
- Be familiar with the standards and requirements for quality management systems.
- Know how to introduce and implement quality management systems in a company according to ISO 9000:2000.
- Have learnt about industry-specific requirements for quality management systems.
- Know how to use methods of quality in the product creation process, in manufacturing and in product application.
- Be able to assess the quality of product using sampling systems.
- Understand statistical process planning and know how to create and assess quality control charts.
- Be able to prepare and carry out machine and process capability studies based on obtained values.
- Know where quality-related costs arise and how important the compilation of these costs can be.

Course content:

- Key relationships in project management
- Objectives and project assignment
- Process models in project management
- Project structure
- Methodology for scheduling and cost planning
- Project controlling
- Project organization and project team leadership
- Development of quality management
- Quality management systems
- Quality jobs within the company
- Quality methods in projects and products lifecycle
- Quality assurance in production
- Quality costs and quality metrics
**Business Language Options:**

**Business Language: English II**

**Learning objectives / competencies:**

By the end of the course students will:

- Have developed comprehensive language communication skills.
- Expanded their knowledge of technical terminology and be familiar with the most important professional activities.
- Have acquired knowledge and expertise in the field of Business English.

**Course content:**

- Improving communicative skills in a vocational context.

**Business Language: French II**

**Learning objectives / competencies:**

By the end of the course students will:

- Have developed comprehensive foreign language communication skills.
- Expanded their knowledge of technical terminology for the most important professional activities.
- Have acquired basic skills in the commercial, cultural and social language characteristics of French-speaking countries.

**Course content:**

- Globally important economic areas and their social, commercial and cultural characteristics
- Subject-specific terminology
6. Compulsory Modules in the 6th Semester

Business Language Options:

Business Language: English III

Learning objectives / competencies:

By the end of the course students will:

- Have developed comprehensive language communication skills.
- Expanded their knowledge of technical terminology and be familiar with the most important professional activities.
- Have acquired knowledge and expertise in the field of Business English.

Course content:

- Improving communicative skills in a vocational context.

Business Language: French III

Learning objectives / competencies:

By the end of the course students will:

- Have developed comprehensive foreign language communication skills.
- Expanded their knowledge of technical terminology for the most important professional activities.
- Have acquired basic skills in the commercial, cultural and social language characteristics of French-speaking countries.

Course content:

- Aspects of business founding
- Writing reports and presentations
- Current specialized topics
Academic Project Work

Learning objectives / competencies:

By the end of the course students will:

- Be able to solve tasks and problems in the industrial environments, such as work organizations and work design, in a scientific way. This includes data collection, analysis, and preparation of solutions, evaluation and implementation, as well as documentation and presentation with the help of professional tools (e.g. project management, simulation).

Course content:

- Use of standard tools for project management, data analysis and simulation
- Project planning and scheduling (temporal, organizational and content-related)
- Research, data collection and analysis
- Documentation and presentation
Key Qualifications

Learning objectives / competencies:

By the end of the course students will:

- Have acquired effective interdisciplinary skills (methodological, social and self-reflective).
- Understand how to apply their knowledge in a successful and sustainable way not only in their Bachelor’s thesis but also in their subsequent career.

Course content:

- Basics of scientific work
- Business ethics
- Basics of intercultural communication
- “Business communication” in a multicultural environment
Industry Placement

(20 weeks)

Learning objectives / competencies:

By the end of the course students will:

- Have gained work experience at the interface between technology and business management in addition to the theory they have already learnt at university.

Course content:

- Testing and deepening of the theory that students have already learned.
- Students will cope with the harsh conditions of working life at the interface between technology and business management.

Study and exam performance:

- Students have to take an oral exam consisting of a presentation about their experience (5 min) and an interview to find out about the work done at the interface between technology and business administration (5 min).
- Internship report
- Essay of approximately 10 pages on lessons learned
7. Compulsory Modules in the 7th Semester

Production Management and Logistics II

Learning objectives / competencies:
By the end of the course students will:

- Understand the basics of procurement and distribution logistics.
- Understand the different models of dispositive procurement and distribution logistics and be able to select them according to specific requirements.
- Have mastered the planning of different types of warehouses and their operator units.
- Be familiar with picking techniques.
- Have mastered the planning of various material handling systems (internal transport).
- Be able to identify optimum packaging and containers.
- Know the right means of transport for domestic and international transportation.

Course content:

- Procurement and distribution logistics
- Logistics engineering
Private Commercial Law

Learning objectives / competencies:

By the end of the course students will:

- Have learnt the basics of business private law (civil law, commercial law and company law) and be able to apply the most important of these laws (Civil Code, Commercial Code and Limited Liability Companies Act).
- Recognize the interfaces between economics and justice and be able to incorporate this knowledge into their decisions and problem-solving tasks.
- Understand the methods used in judicial case preparation.

Course content:

- Civil law that is generally applicable in private matters
- Law of obligations which is essential to the Civil Code
- Commercial law as a special civil right of merchants
- Corporate law as a special civil right of entrepreneurs
- Principles of property law, intellectual property law and insolvency law
People and Organizational Development

(Taught in German and English)

Learning objectives / competencies:

During the course students will:

- Learn the essential elements of leadership in businesses, including both leadership from managers to employees and employees to executives.

The course requires active participation because concepts and theories will be explained as realistically possible (e.g. through discussions, team exercises, role plays). It is expected that students prepare by reading additional articles on this topic.

Course content:

- Leadership models
- Implications of personality in the work environment and team interaction
- Motivation and performance optimization of employees
- Teamwork and group dynamics
- Cooperation in business
- Goal setting and performance dialogues (business performance, people performance)
- HR function in companies
- Personnel selection procedures
- (Top) management communication
- Delegation and time management
Bachelor of Engineering and Management [B.Eng.]

Bachelor Thesis
(In German or English)

Learning objectives / competencies:
Students must be able to show that they can solve a specific problem in the field of industrial engineering in a systematic, independent and practice-oriented way (see § 10 SPO).

Course content:
Students will have the opportunity to choose a topic and work on it in cooperation with a professor. They can also decide to work on a topic that a professor has proposed. Students usually choose topics in cooperation with companies.

Study and exam performance:
Written elaboration of the topic: students have to submit a bound copy of their written thesis and a CD of their completed work to the secretary office. This copy will remain with the company or at the university – wherever the student got their topic from. Students have to discuss the structure, nature and scope of the written thesis with their supervising professor.
8. Subject-Specific Modules

8.1 Industrial Engineering

Processing and Environmental Engineering

Learning objectives / competencies:
By the end of the course students will:

- Be able to critically select the process technologies for constructing production plants.
- Be familiar with the important unit operations.
- Be able to read procedural and other important schemes.
- Be able to plan technical production plants.

Course content:

- Selected unit operations such as screening, sifting, conveying, blending, crushing, classifying, filtering, drying, evaporation, distillation, etc.
- Planning tools for the construction of process plants.
- Examples of the modern process and environmental engineering.
Energy Technology

Learning objectives / competencies:

By the end of the course students will:

- Understand the process of energy transformation and be able to assess these processes in terms of profitability, primary energy consumption and environmental impact.

Course content:

- Energy demand coverage of primary energy consumption, reserves and coverage of primary energy sources and legal framework conditions.
- The process of steam power in coal, nuclear, geothermal and solar thermal power plants.
- Gas and steam power plants and cogeneration of heat and power.
- Photovoltaic, wind energy, ocean energy, fusion.
Product Development and Technical Drawing with CAD

Learning objectives / competencies:

By the end of the course students will:

- Be able to create parts and components with a 3D system and derive technical drawings and other illustrations from them.
- Be familiar with the functions of a finite element program and know how to perform simple optimizations.
- Be familiar with the stages of product development and be able to apply them in a simple product.
- Understand the basic methodical approach to designing.
- Be able to create and dimension simple assemblies with the help of a functional specification document.

Course content:

- 3D CAD class
- Application of an FEM program
- Basics of methodological constructing
- The importance of the functional specification document
- Practical examples of product development including design and calculation
Manufacturing Technology

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the applications of important industrial production procedures for the production of parts for metalworking.
- Be familiar with the typical machines and tools used for selected manufacturing processes.
- Know how to assess the effect of manufacturing parameters on quality and costs and thereby be able to recommend adequate manufacturing procedures.
- Have learnt the methods for calculating the most important manufacturing processes.
- Be able to assess the potential for rationalization to improve productivity and flexibility.

Course content:

- Machining
- Forming
- Machining tools
Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the typical machines and tools used in automation.
- Be familiar with industrial robots and other handling equipment and know where they can be used.
- Have learnt about the applications of important industrial automation components.
- Know about possible solutions to the gradual development of automation.
- Be able to assess the potential for improving automation in manufacturing.
- Have learnt how to create simple CNC programs.

Course content:

- CNC control of machine tools
- Industrial robots and flexible handling systems
- Design and control of automated manufacturing systems
- Measurements to increase productivity and flexibility
- Effective potentials for maintenance
- CNC programming
Product Lifecycle Management

Learning objectives / competencies:

By the end of the course students will:

- Be able to arrange Product Lifecycle Management (PLM) in the operational process map.
- Be able to describe the sub-processes of PLM and its operational and management tasks.
- Have been given an overview of current strategies and priorities in PLM.
- Be able to describe the main components of a PLM structure.
- Understand the importance of an information architecture that forms the basis for the implementation of PLM strategies.
- Be familiar with the different techniques used to model business processes and PLM architectures.
- Be able to apply selected methods of modelling to PLM.

Course content:

- The product lifecycle and the product lifecycle management
- PDM and PLM systems
- PLM components
- Implementation of PLM strategies
- Case studies
8.2 Information Technology

Databases in Engineering and Business

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the methods and techniques used in data management in technical and business management information systems.
- Be able to create a medium-sized “entity relationship model” and the relational DB model.
- Know how to provide data to support decision making in management.

Course content:

The course covers the methods and techniques used in information modelling and making. Students learn the basics of relational database technology and its modern extensions and applications. They also learn SQL language through practical exercises. There are business and technology case studies that students have to prepare.

- Databases versus traditional file processing
- Understanding the concepts of modern database management systems (DBMS)
- Information modelling and knowledge representation
- Entity relationship diagrams and methods of data modelling
- Methods of information retrieval
- Understanding SQL language
- Data integration and access to distributed, heterogeneous and technical data sources
- Metadata management
- Data warehouse technology in operational use
- OLAP functions, applications and solutions
- Case study in a team: problem-oriented creation of a medium-sized complex data model
Software Engineering I

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the methods used in requirements management.
- Be able to create a specification for a business application.
- Know the requirements of good software and the paradigms for software development.
- Have learnt the basics of object orientation using the example of Java programming language.
- Be able to apply techniques for object-oriented modelling.

Course content:

- Requirements management
- Paradigms of software development
- Object oriented programming with Java
- Object oriented modelling with UML
Software Engineering II

Learning objectives / competencies:
By the end of the course students will:

- Be familiar with the methods used in modern software engineering.
- Be able to describe the tasks, methods and tools of software engineering.
- Be able to use and compare process models for software engineering.
- Understand the importance of software architecture.
- Be able to classify and describe modern software architectures.

Course content:

- Tasks, methods and tools for software projects
- Overview of process models
- Best practices for software engineering and the comparison of process models
- Software architecture
- Processing of selected topics in a project work
Embedded Systems

Learning objectives / competencies:

Course content:
IT Project Seminar I

Learning objectives / competencies:

Course content:
IT Project Seminar II

Learning objectives / competencies:

Course content:
8.3 Bio & Environmental Technology

Biotechnological Practice Course

Learning objectives / competencies:
By the end of the course students will:

- Be familiar with the safety requirements for using the laboratory.
- Know how to organize and carry out simple biotechnological processes in the laboratory.
- Be familiar with the critical parameters for growing microorganisms and producing cell components and know how to influence them.
- Be able to assess laboratory processes with regard to times and costs.

Course content:

- Introduction to safety and the organization of biotechnology laboratories
- Creation of a project plan and cost analysis of the laboratory courses
- Performance of basic molecular genetic investigations
- Production and purification of cell contents
Molecular Biology

Learning objectives / competencies:

By the end of the course students will:

- Understand the biochemical basis of life processes.
- Understand the fundamental relationship between metabolism and the growth of organisms and know how to evaluate their significance for biotechnological production processes.
- Know about different forms of cell organization and be able to assess their potential for biotechnological production.
- Understand opportunities for targeted and untargeted change of genotypes and be able to assess their impact on phenotypes.
- Understand the molecular etiology of important diseases and therapeutic strategies derived from them.
- Understand subject terminology and be able to use it appropriately.

Course content:

- Biochemical basis (proteins, nucleic acids, carbohydrates, fats, etc.)
- Basics of metabolism and its importance in growth processes
- Prokaryotic and eukaryotic cells and their production potential
- Central genetic processes (replication, protein biosynthesis, recombination)
- Molecular pathogenesis of major diseases (cancer, Alzheimer’s, etc.)
**Industrial Biotechnology**

**Learning objectives / competencies:**

By the end of the course students will:

- Be familiar with examples of industrial biotechnologies in pharmaceuticals, chemicals, food and agriculture.
- Understand the operating conditions for using microorganisms.
- Have learnt about the potential future opportunities for microorganisms.

**Course content:**

- Properties of microorganisms and cells that can be used industrially.
- Modern industrial biotechnologies used in pharmaceuticals, chemicals, food and agriculture.
- Systematics in the use of microorganisms.
Bioprocessing

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the frequently used unit operations in biotechnology for up and down stream processing.
- Know how to design bioreactors and other equipment in a process-technical way.
- Understand the requirements of sterile techniques.
- Be familiar with the instruments used in production planning (planning of equipment and automation technology).

Course content:

- Processes and their calculation for upstream processing (cultivation, storage) and downstream processing (cell disruption, washing, centrifuging, drying, formulation).
- Reaction engineering
- Sterile techniques
- Methodology for building new facilities with automation
Renewable Resources

Learning objectives / competencies:

By the end of the course students will:

- Understand the potential for producing renewable raw materials.
- Be familiar with potential applications of renewable raw materials.
- Know how phytochemicals are obtained.
- Understand where and how renewable resources can be used for optimal energy use (electricity, heat, fuel).

Course content:

- Potential for producing and applying renewable resources
- Procedures for obtaining phytochemicals
- Innovative methods for extracting energy from renewable resources
- New biological materials
Technical Pollution Control

Learning objectives / competencies:

By the end of the course students will:

- Know the key factors that determine local and global ecosystems.
- Understand how humans can influence local and global ecosystems and their importance.
- Be familiar with the technologies used to reduce or eliminate the problems of local and global ecosystems.
- Be able to evaluate environmental technologies and know which technology to use for certain application areas.

Course content:

- Compartments of the biosphere
- Biotic and abiotic environmental factors
- Ecosystems
- Local and global environmental problem areas
- Political reactions and regulations
- Environmental technologies particularly for wastewater treatment, drinking water treatment, air pollution, soil decontamination, waste treatment, etc.
- Environmental management systems
9. Compulsory Elective Modules

**ERP Basic Knowledge**

**Learning objectives / competencies:**

By the end of the course students will:

- Understand the basic functions and components of business processes and their development in business management software (Enterprise Resource Planning (ERP) systems).
- Have learnt about the interaction between different business processes and have deepened their knowledge through practical exercises.

**Course content:**

- Overview of the example model of business processes on ERP software systems (prototyping) in core business areas such as sales, materials management and materials handling, production planning and control, accounting and finance.
- Creation of an ERP system for business process scenarios (customizing) in the context of model companies.
Management Decision Making Supported by Data Analysis
(Taught in English)

Learning objectives / competencies:
By the end of the course students will:

- Understand the contribution data analysis can make to management decisions.
- Be able to identify decision-relevant data, analyse it from different angles and use this information to support decision making.
- Be able to present data analysis persuasively in English.
- Know how to lead discussion groups competently in English.

Course content:

- Case studies from various corporate functions such as:
  - Cooperate governance
  - Marketing
  - Production
- Extraction and measurement of appropriate parameters from data sets that come from various fields of activities of engineers and business managers.
- Creation of informative charts showing the stylistic demands of disclosure requirements.
- Practising English to guide and orient discussions.
Entrepreneurial Thinking and Acting

Course content:

- Basics of SCM
- Economic assessment procedures
- Balanced Scorecard as a target system
- Process Management
- Cooperation with partner companies
- Support of SCM using IT
Business Process Management

Learning objectives / competencies:

By the end of the course students will:

- Be familiar with the basic procedures for conducting business process improvement projects.
- Understand the methods used in business process modelling and optimization and their inclusion in the architecture of integrated information systems.
- Be familiar with the lifecycle of business processes and operational objectives in business process management.
- Have gained practical experience in modelling and optimizing business processes.

Course content:

- Basic approaches in business process modelling
- Lifecycle of business processes
- Perspectives of the architecture of integrated information systems (ARIS)
- Models and methods for business process modelling (e.g. business process modelling notation (BPMN), event-driven process chain (EPC))
- Developing a marketable tool for business process modelling
- Collecting, modelling and optimizing a real business process in the context of a team project.
Software Systems in Logistics

Learning objectives / competencies:

By the end of the course students will:

- Be able to assess the current most important software-supported processes within various logistics activities, describe their basic functions and evaluate how useful they are.
- Be familiar with the most important functions of current software systems such as the theoretical concepts used by logistics companies.
- Be able to name the typical applications of software systems and explain their advantages.
- Be able to name the basic information technologies and describe their purpose and uses.
- Know how to establish selection criteria for software systems.

Course content:

- Overview of current software systems in logistics.
- Logistics functions in ERP systems, such as ERP suites (e.g. SAP) and best-of-breed solutions.
- Insight into the theoretical foundation of logistics functions and processes needed in planning (projections/forecasting), simulation, optimization (route optimization), control theory (queues) and telematic services (detection, navigation).
- Information technology foundations of software systems in an overview.
- A more detailed analysis of example selected logistics systems such as:
  - Warehouse management systems (warehouse management and order picking systems)
  - Trace and tracking systems
  - Picking systems
  - Material flow control
  - Supply chain management systems
  - Scheduling and distribution systems
  - Layout planning systems
- Developing basic evaluation criteria for the selection of software systems for logistics
Laser Technology

Learning objectives / competencies:

By the end of the course students will:

- Understand the basic physical and technical features and characteristics of a laser beam.
- Be able to interpret a laser beam.
- Be familiar with the main types of lasers and their typical applications in production, metrology and other fields.

Course content:

- Beam formation: What is a laser beam and how is it formed? What are the different types of laser radiation and what types of lasers are there?
- Beam shaping: How does a laser beam become an instrument or a measuring tool? What are the possibilities of beam shaping (mirrors, lenses, optical fibres, etc.)?
- Typical applications in manufacturing (welding, cutting, drilling, coating, cleaning, etc.), in measurement engineering (geometry, speed, etc.) and in other fields (medicine, rapid prototyping, etc.).
Sustainable Development Simulation Game

Learning objectives / competencies:

By the end of the course students will:

- Have deepened their knowledge of the policy areas of the European Union.
- Be familiar with the dimensions of sustainability and sustainable development.
- Understand the complexity of EU policy (including EU policies and institutions).
- Understand the complexity of sustainability.
- Have developed and strengthened their social skills through group work.

Course content:

- Introduction to the issues of sustainability, sustainable development and corporate social responsibility (CSR)
- Introduction to the European Union, guidance awarding and institutions
- Energy policy
- Renewable energy
Change Management
(Taught in English)

Learning objectives / competencies:

Students will be introduced to the process steps associated with “change” and their pitfalls through case study work (individually and/or in small groups) together with group discussion. Our aim is for students to be able to understand the mechanisms of human behaviour that accompany change and how these can be optimally managed to make the process smoother.

Course content:

Each lecture series will be accompanied by case study of work which will build on the lectures and provide practical illustrative examples. There will be time for internet research and to discuss outcomes. Students are expected to supplement their “in course” work with additional research and reading, particularly for the assignment.
Planning and Implementation of Production Lines

Learning objectives / competencies:

By the end of the course students will:

- Be able to align the operational tasks of industrialization with a company’s strategy.
- Understand the procedures for including customers and suppliers in planning and implementation.
- Know how to evaluate manufacturing concepts commercially and technically.
- Be able to identify potential for rationalization to improve productivity and flexibility.

Course content:

- Management of the industrialization process
- Development of manufacturing concepts and process planning
- Implementation of the equipment procurement
Product Ergonomics

Learning objectives / competencies:

Students will learn about the tactile, visual, acoustic and informal interfaces between humans and their environment with regard to their biomechanical, receptor and informational conditions and their dependencies (age, sex, power conversion, etc.).

Course content:

Regularities of the interaction between humans and the environment or humans and machines:

- Informational: tactile, visual, acoustic
- Energy: biomechanical, thermoregulatory product design
- Actuator and control panels
- Hand-held tools
- Displays and input devices, console design
- Software ergonomics and assistance systems
- Seating and reclining systems
- Lighting
- Noise and vibration protection
- Climate and clothing (protective clothing, work clothes and sportswear)
Resource Efficiency and Resource Management

(Taught German and possibly in English)

Learning objectives / competencies:

- The aim of the course is for students to gain the necessary knowledge and skills to work independently on scientific problems in resource efficiency and to learn how to present their findings.
- The module provides students with the necessary multidisciplinary skills and practical experience of project operations to work in interdisciplinary project teams.
- Students will:
  - Work intensively on questions of resource efficiency.
  - Learn about the procedures and methods used to manage projects.
  - Be able to analyse, structure and solve problems independently and in small groups.
  - Independently develop their knowledge, abilities and skills for working in an interdisciplinary team.
  - Be able to present what they have learnt in front of others.

Course content:

- Resource efficiency using the example of the university: students have to consider energy, building and plant engineering, equipment, waste disposal, user behaviour, communication and best practice.
- Work on projects with technical and business tasks, including project management:
  - Definition of project objectives and definition of requirements
  - Structuring of project content and preparation of a project plan
  - Setting up working packages and dividing responsibilities among team members
  - Obtaining and evaluating information
  - Preparation, evaluation and selection of solutions
  - Creating documentation and a presentation
Automotive Project Product Development

Learning objectives / competencies:

By the end of the course students will:

- Have experienced the challenges of an innovative development project in the balancing act between creativity and feasibility.
- Understand the basic relationships in product development.
- Understand the key practices in the product development process.
- Recognize the importance of the basic stages of project work.
- Understand the connections between technical and business success factors in automotive technology.
- Be able to develop a project and create methodologically innovative solutions based on a specific task in the automotive industry.
- Have learnt how to investigate boundary conditions independently, identify measurements and make/justify necessary decisions in a team.

Course content:

- Current challenges in automotive product development
- Stages of the project and product development processes
- Application of innovative management methods
- Goal setting and guidance of project and product goals
Wie viel grün ist drin?

(sorry no description available at the moment)
Aerodynamic Principles for Automotive Design

(Taught in English)

Learning objectives / competencies:

By then end of the course students will:

- Calculate or simulate a laminar flow field for a simple shape (e.g. blunt body, cone, ball or block) at low speeds.
- Describe and perform a simple experiment (designed by the students in teams), e.g. to be provided
- Write about it!

Course content:

Part 1 – Basics of low-speed fluid dynamics:

- Do some experiments
- Figure out what’s going on
- Describe what’s going on mathematically
- Describe what is happening verbally
- Present your experiment

Part 2 – Automotive Design:

- Be able to discuss the ins-and-outs of a two-stroke or a four-stroke internal combustion engine.
- Heating/cooling units
- Exterior Design with various shapes

Tour of a Car Manufacturer with an engineer as the tour guide – (could be either BMW or Audi)