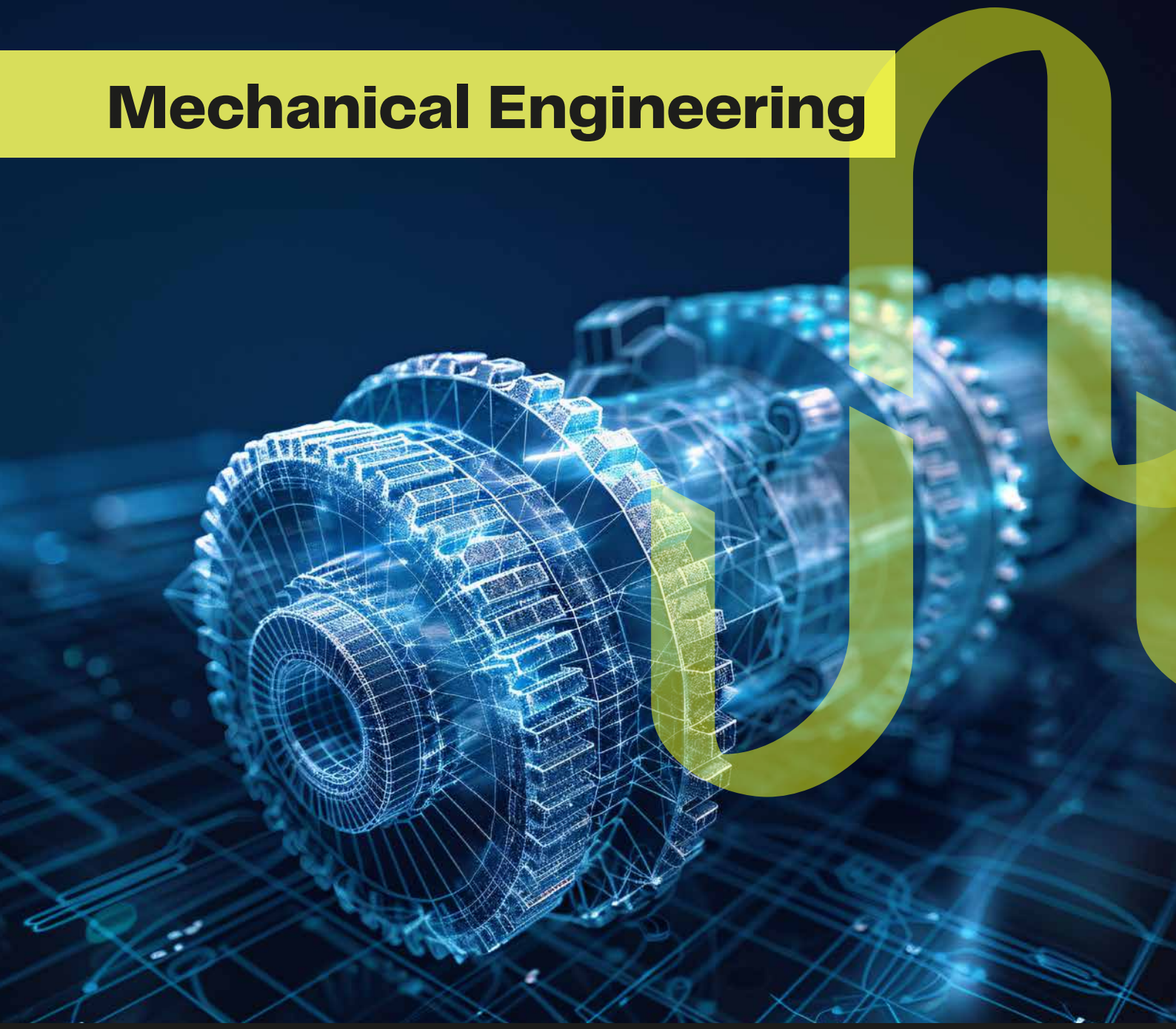
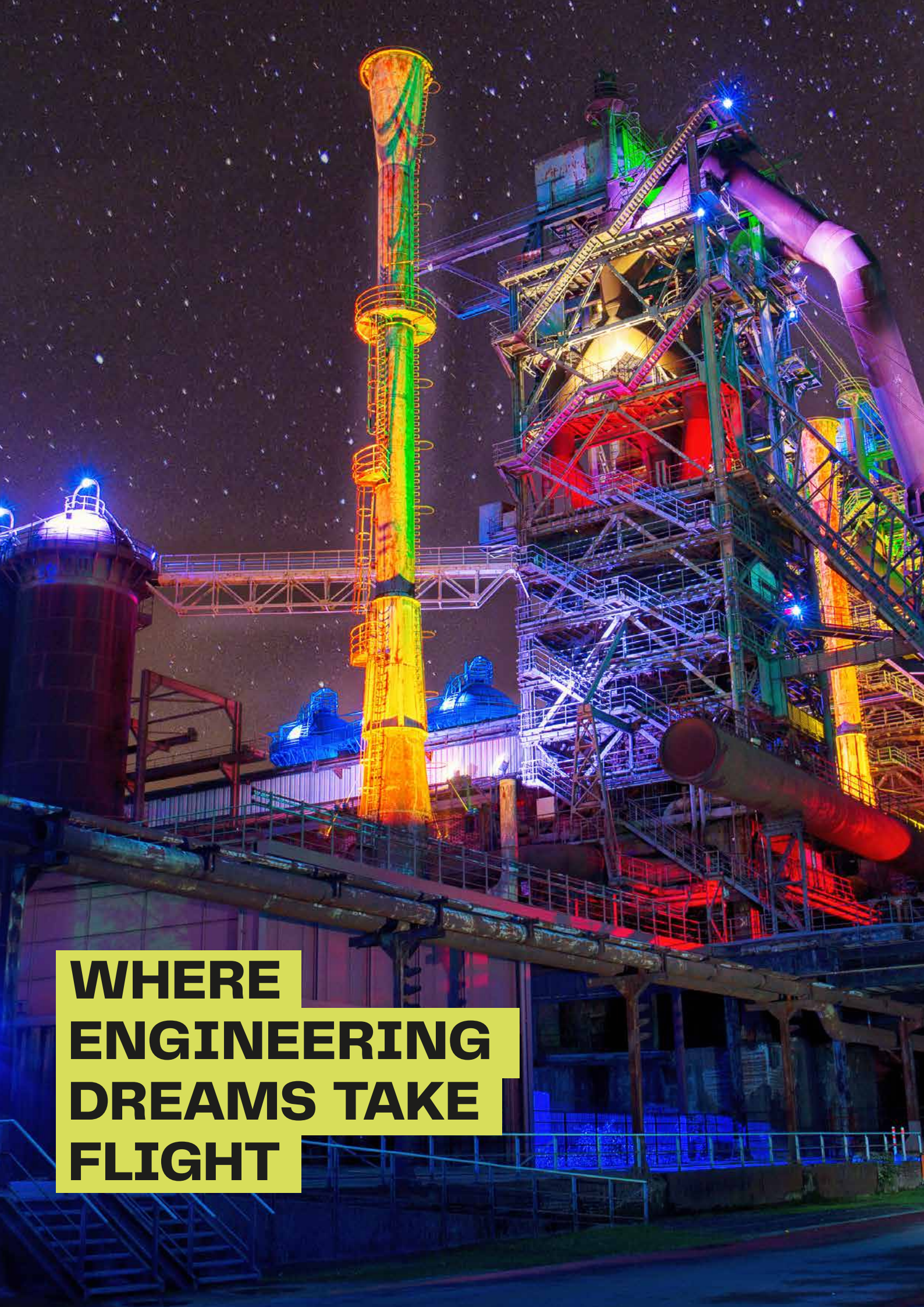
Mechanical Engineering



MODULE MANUAL

SUMMER SEMESTER 2025



WHERE ENGINEERING DREAMS TAKE FLIGHT

Discover the Heartbeat of German Industry

Welcome to the 30 ECTS Program for mechanical engineers in English language at Bochum University of Applied Sciences, Fachhochschule Dortmund – University of Applied Sciences and Arts, and the Westphalian University of Applied Sciences. The program is open to international undergraduate students, offering an insight into the expertise in mechanical engineering on a bachelor level at the three participating universities. It grants an overall unique international experience.

Overview

Preliminary remarks

How to study at three reputable German universities of applied sciences?

When you are a student of the 30 ECTS Program for international incomings, you get the opportunity to study not at one but at three reputable German universities of applied sciences. While you enroll at one of the three universities as an incoming international student, it is necessary to register as a cross-registered student as well to be able to attend the modules at all three universities and thus benefitting from the broader selection of elective modules in English. You will receive detailed instructions on how to enroll as a secondary student at the other two universities. The process is fully digital and simple. No worries. Enrolling as a cross-registered student at the other two universities is free of charge for you.

Exams

Your exam achievements from the other two universities will be recognized by your host university as all three are part of the Higher Education Alliance Ruhr. You will receive detailed guidance on the enrolling process once you have enrolled at your guest university.

Module manual and workload

To prepare your learning agreement, the present module manual gives you the entire choice of courses from the 30 ECTS Program of all three alliance universities. Please be aware that the workload and therefore the number of ECTS for a module might vary according to the requirement of your host university. Please note that a course can only take place if enough students take part.

If you have questions concerning the number of ECTS, please do not hesitate to contact us:

→ study@hochschulallianz.ruhr

Details can be discussed individually.

Please be aware that all information is subject to possible changes.

Program locations

The courses of the 30 ECTS Program take place at the university campuses in Dortmund and in Bochum as well as at the two locations of the Westphalian University of Applied Sciences in Gelsenkirchen and in Bocholt. All modules in this manual are in-class lectures requiring a physical presence of the students at the respective campus. Depending on your choice of modules, you will be required to commute between the universities accordingly. Please become familiar with the locations of Fachhochschule Dortmund - University of Applied Sciences and Arts, Bochum University of Applied Sciences, and the campuses of the Westphalian University of Applied Sciences in Gelsenkirchen and in Bocholt. We will also give you more information on the different locations in an onboarding session.

Please make sure to calculate enough time between the seminars on the different campuses. (The commute with public transportation can vary from one hour between the campuses in Bochum and Dortmund up to two and a half hours to Bocholt from Bochum or Dortmund and vice versa). Your semester ticket allows you to shuttle at no extra costs and you have a sustainable journey between the different cities.

Exploring public transportation as an international student

Mobility in Metropolitan Area Ruhr

HIGHER EDUCATION ALLIANCE RUHR

What is the Higher Education Alliance Ruhr?

The 30 ECTS Program for international exchange students is an offer of the Higher Education Alliance Ruhr. The Higher Education Alliance Ruhr is a consortium of Universities of Applied Sciences in the Ruhr area consisting of Bochum University of Applied Sciences, Fachhochschule Dortmund - University of Applied Sciences and Arts, and the Westphalian University of Applied Sciences. They cooperate in various fields, seeking to strengthen their international visibility, their networking and exchange opportunities as well as the mobility of their students, lecturers, researchers, and staff. The goal of the university alliance is to promote cross-border, intercultural exchange as well as international competences to prepare students for an international career.

The Higher Education Alliance Ruhr enables students to choose from a broader range of offers, to set an individual focus in their studies and to look beyond their own horizons.

Contact information

Program coordinator:

For further information about our 30 ECTS program, please contact our program coordinator. Feel free to schedule a video call.

study@hochschulallianz.ruhr

ADDITIVE MANUFACTURING OF METALS

Westphalian University of Applied Sciences, Campus: Gelsenkirchen

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h	3rd semester / Bachelor	One semester	Summer semester

Courses	Attendence Time	Self-Study	Group Size
Seminar lecture 3 h Project-related practical course 1 h (per semester week)	60 h	120 h	

Learning outcomes/Objectives

After completing the lecture “Additive Manufacturing of Metals, students will have comprehensive basic knowledge in the fields of various additive manufacturing processes, the behaviour of metallic materials during additive manufacturing and the resulting mechanical properties. They will be able to explain and apply the associated scientific principles.
Based on the ‘process-properties-performance’ chain, students are able to independently design a suitable process for a material and specifically evaluate a correspondingly manufactured component.

Contents

- Additive manufacturing processes
- Possibilities and application of additive manufacturing
- Behaviour of metallic materials in additive manufacturing
- Mechanical properties of additively manufactured components
- Post-Processing

Teaching Methods

Seminar lecture, project-related practical course (group work in the laboratory)

Participation Requirements (Prerequisites/ Eligibility)	Requirements for award of ECTS points
Fundamentals of joining technology and materials engineering	

Forms of examination (Type)	Requirements for taking the exam
Written examination, prerequisite is successful participation in the project-related internship	None

Module Coordinator and fulltime lecturer

Prof. Dr.-Ing. Ghazal Moeini, IWE

Literature / Resources:

- Berger, Uwe; Hartmann, Andreas; Schmid, Dietmar: Additive Fertigungsverfahren. Rapid Prototyping, Rapid Tooling, Rapid Manufacturing. Haan-Gruiten: Verl. Europa-Lehrmittel. 1. Aufl, 2013
- Lachmayer, Roland, Lippert, Rene Bastian Additive Manufacturing Quantifiziert, Visionäre Anwendungen und Stand der Technik, Springer Vieweg Verlag, 2017, E-Book: ISBN 978-3-662-54113-5
- International publications

ADDITIVE MANUFACTURING WITH PLASTICS

Fachhochschule Dortmund – University of Applied Sciences and Arts

ECTS	Workload	Study Semester	Duration	Frequency
2			3 Days	Summer semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
24 h lectures and exercises			12	40

Learning outcomes/Objectives

Students possess the basic knowledge of Additive Manufacturing and are familiar with the terminology. They understand the main 3D printing processes and can evaluate, compare, and select them based on scientific criteria. They have mastered the basic process chain for 3D printed components. The students are able to practically perform this process chain for the Fused Layer Modeling (FLM) technology and are capable of designing and manufacturing objects suitable for 3D printing.

Contents

- Daily Schedule: Each day contains a lecture in our standard lecture room. Here, we'll cover essential theories and concepts underpinning 3D design and printing technologies. Following the lecture, students will move to the laboratories for a hands-on practical session that applies the day's learning.
- Practical Application: Students will be assigned a specific task to design and print, allowing you to apply concepts in real-time and produce tangible outcomes. The design tasks will be chosen to challenge your creativity and technical skills.
- Duration: This course runs over a three-day period, with continued access to lab facilities and equipment during this time to ensure iterative learning and project completion.
- Teamwork: Participation in multidisciplinary groups is mandatory, promoting a collaborative environment that brings diverse skills and perspectives together. This is crucial in understanding different aspects of design and manufacturing processes.
- Assessment: Group grading will be based on the quality of the design results, fostering a commitment to excellence and precision among participants.

Prerequisites:

- Knowledge of CAD software, specifically Solidworks, is preferred. This will help participants to fully engage with the practical aspects of the course.

This workshop is ideal for students, professionals, and enthusiasts eager to delve into the world of 3D printing and design. Whether you are looking to polish up your skills or start from scratch with some foundational knowledge, this course offers a comprehensive platform to learn, create, and innovate.

Module Coordinator and full-time lecturer

Prof. Dr. Thorsten Sinnemann

BIOMIMETIC SENSOR SYSTEMS I

Westphalian University of Applied Sciences, Campus: Bocholt

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h	4th semester / Bachelor	1 semester	Every Summer semester

Courses	Attendence Time	Self-Study	Group Size
Lecture 2 h	30 h	60 h	Lecture: limited as per notice
Practical training 2 h (per semester week)	30 h	60 h	Practical training: 15

Learning outcomes/Objectives

The participants learn independently scientific experiments using biological, technical and bionic models to design and implement and to implement theoretical concepts in a technical structure and later interdisciplinary.
Being able to work on projects in the fields of biomechanics, bionics, neuroethology, biorobotics are further objectives of this module.

Contents

- Applying methods of measurement technology, data acquisition, processing and filtering and thus recording and analysing sensor data
- Uni- and multivariate descriptive and inductive statistics
- Electronic data recording and processing
- Effective principles of technical and biomimetic sensor principles
- Developing hypotheses and deriving experimental approaches from them
- Behavioural experiments on living organisms
- Technical basics of mobile robots

Teaching Methods

Lecture, practical training

Participation Requirements (Prerequisites/ Eligibility)	Requirements for award of ECTS points
Participation in the Practical Training of Physics, BIN, BIO3. Eligibility to participate in this course is subject to individual assessment. Please directly contact the lecturer for more information.	Passing the examination and the practical training
Forms of examination (Type)	**Requirements for taking the exam**
Written examination	None

Use of the module

Compulsory module of the Bachelor of Biomimetics degree

Importance of the grade of the module to the final score

According to the examination regulations

Module Coordinator and full-time lecturer

Prof. Dr. Tobias Seidl

Additional Information:

The current literature will be announced by the lecturer at the beginning of the module.

DEVELOPMENT PROJECT

Bochum University of Applied Sciences

ECTS	Workload	Study Semester	Duration	Frequency
5	150 h	6th semester	1 semester	every semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
EP: Development project		148 h	102 h	Up to 3

Learning outcomes/Objectives

The student should carry out a development project either individually or as part of a team. In the latter case, the student should demonstrate their own ‚interdisciplinarity', ‚ability to work in a team' and ‚ability to integrate' within the team.
This discipline serves to optimize the professional profile. The elements ‚interdisciplinarity', ‚ability to work in a team' and ‚ability to integrate', which belong to the key qualifications, are practiced through group work.
Within the development project, students should apply and expand the methodological skills they have already acquired. In addition to methods for technical problem solving, management tasks and moderation tasks are also applied. In the problem-solving methods, students are taught the basics of scientific work. Theoretical knowledge will be used to develop guidelines for practical implementation.
The mechatronic development process should be practiced at least in part.
Students who choose the specialization „International Engineering" should choose an „International Development Project".

Contents

Project topics are assigned according to the research focus of the individual laboratories

Teaching Methods

Project work individually or in groups

Requirements for award of ECTS points	
Passed presentation and report	
Forms of examination (Type)	**Requirements for taking the exam**
Module examination in the form of a report and presentation	None

Importance of the grade of the module to the final score

5/ Sum of the weighted ECTS relevant to the examination

Module Coordinator and full-time lecturer	
Prof. Dr.-Ing. Tim Richard, all laboratories	

ENERGY TECHNOLOGY

Westphalian University of Applied Sciences, Campus: Bocholt

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h	4th semester / Bachelor	1 semester	Every Summer semester

Courses	Attendence Time	Self-Study	Group Size
Lecture 2 h	30 h	60 h	Lecture: limited as per notice
Practical training 2 h (per semester week)	30 h	60 h	Practical training: 30

Learning outcomes/Objectives

The students know the principals of transforming primary energy into electrical energy, thermal energy as well as mechanical energy and the particular challenges of a sustainable energy supply. They are able to create energy balances and mass balances for the mutual transformation of the different types of energy into one another. They have basic knowledge of functionality and control of the electrical grid. The students are familiar with technical energy management of companies, they know technical measures to improve ist sustainability and are qualified to manage the implementation of those measures.

Contents

- Energy units, basic concepts and key figures (efficiency factor, capacity factor, coefficient of performance, seasonal performance factor)
- Efficiency, consistency and sufficiency in energy industry / energy technique; challenges of a sustainable energy supply
- Processes for the production of electricity and heat: conventional power plants, renewable energies (plants using energy of sun, wind, water [height difference], waves, tides, geothermal heat or biomass)
- Energy storage: chemical/physical long-term storage and short-term storage for electrical, thermal or mechanical energy
- Thermodynamic treatment of energy transformations: mutual transformation of chemical, mechanical, thermal and electrical energy as well as light energy into one another; separately: Rankine Cycle, photovoltaics, heat pumps
- Energy balances and mass balances of chemical processes for energy production and energy storage (Power-to-X)
- Management of the electrical grid, power drain and power input, control of the utility frequency, smart grids, digital transformation of the energy supply
- Energy and mobility, Sector coupling
- Technical energy management in companies, data collection and intelligent control of energy flows

Teaching Methods

Lecture, practical training

Forms of examination (Type)	Requirements for taking the exam
Oral examination	None

Use of the module

Compulsory module of the Bachelor degree „Sustainable Engineering and Management“

Importance of the grade of the module to the final score

According to the examination regulations

Module Coordinator and full-time lecturer

Prof. Dr.-Ing. Marcel Seiler

Additional Information:

Recommended literature will be announced by the lecturer at the beginning of the module.

ENGLISH FOR SCIENCE AND TECHNOLOGY

Westphalian University of Applied Sciences, The Language Center, Campus: Gelsenkirchen

ECTS	Workload	Study Semester	Duration	Frequency
5	150 h		1 Semester	Every semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
		60 h	90 h	20 - 30 students

Learning outcomes/Objectives

Upon completion students will be able to engage successfully in occupation-oriented and academic discourse settings using appropriate English while taking into account (inter)cultural elements.

Contents

The course covers technical English language requirements with respect to engineering and scientific topics and professional communication, taking into account technical texts, documents and documentation. Methodological and content-related aspects include

- understanding technical texts and documents,
- report writing,
- presenting diagrams,
- presentations,
- formulae and mathematical expressions,
- product and process descriptions,
- listening exercises on science and technology

Teaching Methods

Scheduled on-site teaching using a wide array of media. The classroom teaching is complemented by guided and independent study periods which are supported by a wide range of digital learning resources offered by the Language Centre (see below).

Participation Requirements (Prerequisites/ Eligibility)	**Requirements for award of ECTS points**
Formal: none In terms of content: advanced English skills as stipulated by the German University and Higher Education entrance regulations If needed: attendance of the “English Support Programme (ESP)” offered by the Language Centre	A minimum of 50% (50 points out of 100)
Forms of examination (Type)	**Requirements for taking the exam**
Written exam (120 min)	None
Module Coordinator	**Lecturers**
The Language Centre	Julia Brassat, MA; Dr. Thorsten Winkelräth et al. (The Language Centre)

Additional Information:

Resources → p. 22

FIBER-REINFORCED COMPOSITE

Fachhochschule Dortmund – University of Applied Sciences and Arts

ECTS	Workload	Study Semester	Duration	Frequency
2			3 Days/ mid Aug 2025	Summer semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
24 h lectures and exercises		24	36	40

Learning outcomes/Objectives

Students are familiar with the structure and different construction methods of vehicle bodies, as well as the requirements for modern vehicle bodies. They understand the crash behavior of different constructions and material combinations.
Students have foundational knowledge of fiber-reinforced plastics. They are familiar with the methods for calculating reinforced plastics (Classical Laminate Theory) and the design of sandwich components. They can appropriately design laminates and sandwich structures according to needs.
Students know the methods for manufacturing fiber-reinforced body components and the advantages and applications of sandwich structures, and they have basic knowledge in the fiber-oriented design of body components.
Students are proficient in the process chain for the production of laminating tools and can independently (under expert supervision) carry out the CAD-CAM process steps from the CAD model to the creation of a CNC-milled prototype.
Students have practical experience in manufacturing body components using the infusion process and through the use of pre-impregnated materials.

Contents

Course Description:
- Engineering Lightweight Structures with Composites
- This intensive three-day course is designed for participants interested in the theoretical background and practical applications of engineering lightweight structures using composite materials. Ideal for engineers, designers, and technical personnel, this course combines classroom theory, software simulation, and hands-on laboratory experiments to provide a comprehensive understanding of the subject.

Day 1: Theory and Foundations
- Morning Session: The course begins with a theoretical introduction to lightweight engineering, emphasizing the role and application of composite materials. Participants will explore the properties, benefits, and challenges associated with composites in engineering applications.
- Afternoon Session: The basics of Finite Element Analysis (FEA) are covered, providing participants with foundational skills in computational analysis necessary for designing and analyzing composite structures.

Day 2/3: Advanced Simulation Techniques
- The entire second day is dedicated to the simulation of composites using Finite Element Analysis (FEA). Participants will engage in detailed simulation tasks that mimic real-world composite applications, enhancing their ability to model and predict the behavior of composite materials under various conditions.

Prerequisites:
- Participants are expected to have prior knowledge of CAD (Computer-Aided Design) and a basic understanding of Strength of Materials. This foundational knowledge is crucial for maximizing the learning outcomes and fully engaging in all aspects of the course.

Module Coordinator and full-time lecturer

Prof. Dr. Matthias Müller

FUNDAMENTALS OF MANUFACTURING PROCESSES

Westphalian University of Applied Sciences, Campus: Gelsenkirchen

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h	3rd semester / Bachelor	1 semester	Summer semester

Courses	Attendence Time	Self-Study	Group Size
Lecture 3 h Exercises 1 h (per semester week)	60 h	120 h	

Learning outcomes/Objectives

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

- Demonstrate an overview of essential subtractive manufacturing processes and their practical applications.
- Assess the properties and applications of cutting materials and tools.
- Analyze and apply principles of cost-efficiency in manufacturing.
- Explain the importance, selection, and use of cooling lubricants.
- Evaluate the machinability of different materials.
- Explain and apply the processes of cutting with geometrically defined and geometrically undefined cutting edges.
- Explain various methods of electrical discharge machining, chemical machining, and electrochemical machining, and identify their applications.
- Explain the fundamentals of heat treatment and its effects on materials.

Contents

Professional Knowledge and Procedures:

-
- Introduction to various manufacturing processes and their significance in industry
- Properties and selection criteria for cutting materials, tool types, and their areas of application
- Methods for analyzing and improving the cost-efficiency of manufacturing processes
- Importance, function, and selection criteria of cooling lubricants in different manufacturing processes
- Factors affecting machinability and evaluation of the machinability of various materials
- Principles and techniques of turning, milling, drilling, and other cutting processes with geometrically defined cutting edges
- Advanced knowledge in grinding, honing, lapping techniques, and cutting processes with geometrically undefined cutting edges
- Processes of electrical discharge machining, chemical machining, and electrochemical machining
- Fundamentals of heat treatment and its influence on material properties

Teaching Methods

Lecture in seminar form with accompanying exercises, in which students learn to solve problems independently.

Requirements for award of ECTS points	
Passed written exam (grade)	

Forms of examination (Type)	Requirements for taking the exam
Exam (90 min) at the end of the semester	None

Module Coordinator and full-time lecturer	
Prof. Dr.-Ing. Ali Zahedi	

GERMAN AS A FOREIGN LANGUAGE: BASIC COURSE

Westphalian University of Applied Sciences, Campus: Gelsenkirchen

ECTS	Workload	Study Semester	Duration	Frequency
5	150 h		One semester	Every semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
		60 h	90 h	Max 30 students

Learning outcomes/Objectives

Communicative and cultural competence in the German language on a basic level.

Contents

Introduction to the basic structures of the German language:
The course offers an introduction to German as a foreign language for beginners. It will cover basic vocabulary and grammar needed in everyday situations and academic settings. Cultural aspects related to the respective topics will be addressed throughout the course. Following a blended-learning approach, the course will be completed by digital content.

Teaching Methods

Seminar and others

Participation Requirements (Prerequisites/ Eligibility)	**Requirements for award of ECTS points**
None	At least 50% (50/100 pts)
Forms of examination (Type)	**Requirements for taking the exam**
Written exam (120 min); no aids (e.g., dictionaries) permitted	None
Module Coordinator	**Lecturer**
The Language Centre	Julia Brassat, Dr. Tobias Budke et al. (Language Centre – Sprachenzentrum)

Additional Information:

The course will include the systematic use of classic and interactive media in the classroom and in the Language Centre's multi-media lab.

Transcript of records

Lasers: Basic principles and applications
Laser principle, Properties, Types of lasers, Applications in industry and research

HIGH PERFORMANCE MACHINE TOOLS AND AUTOMATION TECHNOLOGY

Fachhochschule Dortmund – University of Applied Sciences and Arts

ECTS	Workload	Study Semester	Duration	Frequency
2			3 Days	Summer semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
24 h lectures and exercises		24	36	40

Learning outcomes/Objectives

Upon successful completion of this two-day workshop, participants will be able to:
- Assemble a CNC Milling Machine
- Understand CNC Machine Operations
- Program CNC Machines
- Apply theoretical concepts reviewed in pre-course materials practically, linking theory to real-world application in CNC technology.

Contents

Day 1: Machine Assembly and Operation
- Part 1: Build a CNC Milling Machine
  Participants will begin by constructing their own CNC milling machine from provided components found in a scrap box. This task is designed to challenge and enhance mechanical understanding and problem-solving skills, as no instruction manual will be provided.
- Part 2: Demonstration
  After assembling the machine, participants will learn the basic operations of the CNC milling machine. The session includes a comprehensive demonstration, ensuring that all students can safely and effectively manage their equipment.
-

Day 2: CNC Programming and Application
- Full Day: Programming and Engraving
  The second day is dedicated to understanding the software driving CNC machines. Held in the CAD room, this session involves two students per computer to facilitate collaborative learning and hands-on programming practice. The primary task will be to program the CNC machine to perform intricate engraving tasks, applying the theoretical knowledge gained on the first day.

Prerequisites:
- Participants are required to prepare by reviewing uploaded material on the ILIAS platform prior to the course to ensure a smooth transition into practical activities.
-

Ideal Participants:
This workshop is perfect for students, hobbyists, and professionals who are interested in gaining practical experience in CNC technology. Whether you‘re looking to enhance your resume, kickstart a project, or simply expand your technical skills, this workshop will provide valuable hands-on learning.
Make the most of this opportunity to learn, create, and innovate in the realm of CNC machining, and gain not just skills but also confidence in using advanced manufacturing tools.

Module Coordinator and full-time lecturer

Prof. Dr. Stefan Hesterberg

LEAN PRODUCTION

Fachhochschule Dortmund – University of Applied Sciences and Arts

ECTS	Workload	Study Semester	Duration	Frequency
2		3 Days, Mid of August 2025		Summer semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
24 h lectures | and exercises		24 h	36 h	40

Learning outcomes/Objectives

- Understanding of fundamental principles of production management and organization.
- Ability to create key production documents such as bills of materials, process flow charts, and work plans.
- Knowledge of Lean Production and designing efficient production systems.
- Understand and implement Visual Management and KPIs in production by designing a Shopfloor Board
- Competence in Value Stream Mapping to visualize and design material and information flow.
- Applying theoretical concepts to industry-oriented case studies.

By the end of the course, students will have a solid understanding of production management and organization concepts, along with practical skills that have been applied in industry-oriented exercises. This blend of lectures and hands-on activities will equip students for effective management and optimization in production environments.

Contents

This course provides an in-depth exploration of key concepts in production management and organization, structured through lectures and practical exercises.

Lecture 1: Kick-off and Basics of Production Management and Organization
The course begins with an overview of fundamental principles in production management. This initial lecture sets the scene for the entire course and covers essential organizational strategies.
Exercise 1 revolves around the creation of key production documents. In Part 1, students develop vital documents necessary for production planning. Part 2 involves crafting a bill of materials, a process flow chart, and a work plan. The session concludes with a presentation and a discussion on the results, providing a platform for feedback and learning.

Lecture 2: Basics of Lean Production and Production System Design
This lecture introduces students to the principles of Lean Production, focusing on efficiency and waste minimization in the production process. Students will learn about designing effective production systems that align with lean methodologies.
In Exercise 2 participants will apply their understanding of visual management principles and key performance indicators (KPIs) by designing a functional shopfloor board. The goal is to create a visual tool that effectively communicates critical production data, supports decision-making, and fosters team alignment. The exercise ends with a presentation where students discuss their results and benefit from peer and instructor feedback.

Lecture 3: Value Stream Mapping and Design
Focusing on Value Stream Mapping (VSM), this lecture illustrates the method of visualizing and designing the flow of materials and information required to bring a product to a customer.
Exercise 3 immerses students into applying VSM by first drawing a Current State Map (CSM) in Part 1. In Part 2, students progress to drawing a CSM and a Target State Map, outlining potential improvements and future state planning. Again, the exercise culminates in a presentation and comprehensive discussion, fostering a deeper understanding of the concepts.

Module Coordinator and full-time lecturer

M.Sc. Leonie Potthoff / Prof. Dr.-Ing. Lisa Gunnemann

MATERIALS SCIENCE

Westphalian University of Applied Sciences, Campus: Gelsenkirchen

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h		1 semester	Summer semester

Courses	Attendence Time	Self-Study	Group Size
Lecture 2 h Exercise 1 h Lab course 1 h (per semester week)			

Learning outcomes/Objectives

Professional competences:
Students are able to explain the fundamentals of (metallic) materials. They are capable of identifying correlations between chemical bonds and material properties. They can name the essential mechanical properties of (metallic) materials and the most important testing methods for determining these properties. Furthermore, students can apply the fundamentals of materials science to different material groups. Taking into account mechanical and/or chemical stress, they can make a targeted selection of materials for practical use.

Personal competences:
Students are able to work in teams. They act fairly and cooperatively and can handle conflicts appropriately. Students actively contribute to the development of topics. Furthermore, they work independently and take responsibility for their own performance.

Contents

- Introduction
- Structure and Classification of Material Groups
- Metals - Crystalline Structure
- Metals - Deformation
- Metals - Alloy Formation
- Metals - Phase Transformations
- Metals - Thermally Activated Processes
- Steel - Heat Treatment
- Steel - Alloying Elements
- Steel - Steel Groups
- Non-Ferrous Metals

Teaching Methods

Lecture, exercise, lab course

Requirements for award of ECTS points	
Passed exam	

Forms of examination (Type)	Requirements for taking the exam
Exam (prerequisite is a successful participation in the lab course)	None

Module Coordinator and full-time lecturer	
Prof. Dr. Deniz Kurumlu	

Additional Information:

Literature:
Bargel, H.-J./ Schulze, G. (2012): Werkstoffkunde. 11., bearbeitete Auflage, Berlin Heidelberg: Springer-Verlag

STATISTICS FOR ENGINEERING SCIENCES

Bochum University of Applied Sciences

ECTS	Workload	Study Semester	Duration	Frequency
5	150 h		1 Semester	Summer semester

Courses	Attendence Time	Self-Study	Group Size
2 h lecture | 1 h exercise | 1 h practical training (4 h per semester week)	64 h	86 h	

Learning outcomes/Objectives

The students learn how to apply standard descriptive methods to univariate and to multivariate data. They are familiar with the basic concepts of probability theory and common para- metric distribution models. They know when and how to apply common hypothesis tests.

Contents

- Types of data measurement scales
- Describing empirical data sets
- Graphical representation
- Kolmogorov's laws of probability
- Conditional probability and independent events
- Bayes theorem and law of total probability
- Random variables, expectation, and variance
- Discrete parametric distribution models
- Continuous parametric distribution models and density functions
- Point estimation and interval estimation
- Concepts of hypothesis testing Binomial tests
- Tests using normal distribution assumption

Teaching Methods

Lecture, Exercise, Practical training (with R / R Studio)

Participation Requirements (Prerequisites/ Eligibility)	Requirements for award of ECTS points
Mathematik I and II	Passing the exam and successful participation in the practical training

Forms of examination (Type)	Requirements for taking the exam
Written exam	None

Use of the module

tba

Module Coordinator and full-time lecturer

Dipl.-Math. André Thrun

TECHNICAL ENGLISH – MECHATRONICS/MECHANICAL ENGINEERING

Westphalian University of Applied Sciences, Campus: Bocholt

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h		One semester	Summer semester

Courses	Attendence Time	Self-Study	Group Size
Technical English – Mechatronics/Mechanical Engineering	60 h	120 h	20 - 30 students

Learning outcomes/Objectives

Upon completion students will be able to engage successfully in occupation-oriented and academic discourse settings using appropriate English while taking into account (inter)cultural elements.

Contents

The course is an introduction to technical English language based on selected topics from various relevant fields, e.g.:

- basic geometry and algebra,
- mechanics,
- robotics,
- automotive systems and
- renewable technologies.

Teaching Methods

Scheduled on-site teaching using a wide array of media. The classroom teaching is complemented by guided and independent study periods which are supported by a wide range of digital learning resources offered by the Language Centre (see below).

Participation Requirements (Prerequisites/ Eligibility)	Requirements for award of ECTS points
Formal: None In terms of content: advanced English skills as stipulated by the German University and Higher Education entrance regulations If needed: attendance of the “English Support Programme (ESP)” offered by the Language Centre	A minimum of 50% (50 points out of 100)
Forms of examination (Type)	**Requirements for taking the exam**
Written exam (120 min)	None
Module Coordinator	**Lecturer**
The Language Centre	Mark Weller M.A., Dr. Thorsten Winkelräth et al. (The Language Centre)

Additional Information:

Resources → p. 24

TRIBOLOGY

Westphalian University of Applied Sciences, Campus: Gelsenkirchen

ECTS	Workload	Study Semester	Duration	Frequency
6	180 h	5th semester / Bachelor	1 semester	Every summer semester

Courses	Attendence Time	Self-Study	Group Size
Lecture 2 h Exercise 1 h Practical training 1 h (per semester week)	60 h	120 h	Lecture: unlimited Exercise: 20 Practical training: 16

Learning outcomes/Objectives

Upon succesful competion of the module, students will be able to:
- analyse tribological systems and determine tribological stresses
- know the essential properties of friction, wear and lubrication
- know the most important tribological measuring and testing techniques
- assess tribological materials consisting of tribotechnical materials and lubricants
- be familiar with the methodology for dealing with friction and wear problems.

Contents

Professional Knowledge and Procedures:
- The lecture deals with general questions of tribology and lubrication technology.
- The function and structure of tribological systems are explained.
- System analysis is used to systematically organise the parameters and influencing variables of the tribological system.
- The lecture focuses on friction, wear and lubrication.
- Furthermore, the tribological measuring and testing techniques used daily in industry are presented, from laboratory testing technology to operational testing technology.

Teaching Methods

Lecture in seminar form with accompanying exercises
Practical training for practical application

Participation Requirements (Prerequisites/ Eligibility)	Requirements for award of ECTS points
	Passed wirtten exam (grade)

Forms of examination (Type)	Requirements for taking the exam
Exam (120 min) at the end of the semester	None

Use of the module

Importance of the grade of the module to the final score

Module Coordinator and full-time lecturer

Prof. Dr.-Ing. Christoph Lohmann

Resources:

Last edition in each case:
- Czichos/Habig, Tribology-Handbook, Springer Vieweg
- Bauer, Tribology, Springer Vieweg
- Bartz, Einführung in die Tribologie und Schmierungstechnik, expert Verlag
- Meyer, Kloß, Reibung und Verschleiß Reibsysteme, expert Verlag
- Murrenhoff, Umweltverträglice Tribosysteme, Springer Verlag
- Schlecht, Maschinenelemente 1, Perason Studium
- Schlecht, Maschinenelemente 2, Perason Studium
- Schaeffler, Technisches Taschenbuch, Schaeffler Technologies AG & Co.KG
- Sauer, Konstruktionselemente des Maschinenbaus 1, Springer Vieweg

UNMANNED AERIAL VEHICLES

ONLINE

Bochum University of Applied Sciences

ECTS	Workload	Study Semester	Duration	Frequency
5	150 h	5th semester / Bachelor	1 semester	Summer semester
Courses		**Attendence Time**	**Self-Study**	**Group Size**
Unmanned Aerial Vehicle		64 h	86 h	V60, SV35, Ü20, P15, S15, EDV-P30

Learning outcomes/Objectives

- What are the fundamentals and various types of Unmanned Aerial Vehicles (UAVs) and its challenges.
- Understand the kinematics and dynamics constrains.
- Select and use the suitable sensors for real-time applications.
- Deploy the UAVs with efficient communication systems.
- Manage the power requirement for various UAV applications.
- Design and identify advance techniques to solve real-world problems.

Contents

- Unmanned Aerial Vehicle (UAV) Fundamentals – Deign Principles - Basic Mechanics – Component Selection – System Architecture
- Basics of Kinematics and Dynamics – Quadrotor and Fixed Wing UAVs
- Sensors – EO, LIDAR, RADAR, GNSS, Gyroscope – Maps and Security
- UAV Communication – Radio communication – Frequency Bands and Cellular Technology
- Deployment of UAV – Trajectory Optimization – On Board Energy
- Battery Management Techniques – Power allocation – Position Optimization – Efficient Deployment – Energy Harvesting
- Threats to UAV – Confidentiality Attacks – Integrity Attacks – Authenticity Attacks – Research Challenges
- Advance Techniques in UAV – Internet of Things – Enabling IoT – IoT Intelligence - Issues and challenges
- Design and Research Applications – Sustainability - Case Studies

Teaching Methods

Lectures, seminar lessons, project work in groups

Requirements for award of ECTS points

Passed the exam and successfully completed the Project works with Reports

Requirements for taking the exam

None

Forms of examination (Type)

Module examination in the form of a 90-minute exam, presentations and project work during the semester

Bonus regulation:
Voluntary preliminary work according to §9a Bachelor Framework Examination Regulations can be offered by the person responsible for the module. At the beginning of the lecture period, the students will be informed about how these voluntary prerequisite courses are to be taken.

Importance of the grade of the module to the final score

5/ Sum of the weighted ECTS relevant for the examination

Module Coordinator and full-time lecturer

Prof. Arockia Selvakumar Arockiadoss; Lecturer: Prof. Arockia Selvakumar Arockiadoss

Additional Information:

This module takes place online.

Resources

ENGLISH FOR SCIENCE AND TECHNOLOGY

Course Book:

David Bonamy (2011), TECHNICAL ENGLISH 4 (course book),
Pearson/Longman: Harlow. ISBN- 978-1-4082-2955-2

Internet-websites of Technology / Engineering / Science - related magazines e.g.:

- www.ingenia.org.uk
- https://eandt.theiet.org
- https://www.sciencedaily.com
- www.quantamagazine.org

https://www.facilitiesshow.com

- https://scitechdaily.com
- https://techxplore.com/engineering-news/ (formerly: https://www.phys.org/technology-news/engineering)
- https://www.theengineer.co.uk
- https://www.nsf.gov/news/
- https://spectrum.ieee.org
- https://www.snexplores.org/ (formerly: https://www.sciencenewsforstudents.org/)

Web-based tutorials and educational materials, e.g.

- www.howstuffworks.com (e.g. how Anti-Lock Brakes work)

Various YouTube Channels on topics like

- maths (e.g. numberphile)
- physics (e.g. the Large Hadron collider)
- electronics (e.g. LASER technology)
- mech. engineering (e.g. material properties)
- fac. engineering (e.g. smart buildings/the internet of things)

IT/Multimedia-related (audio-video) podcast sources, e.g.:

- www.thenakedscientists.com

International Broadcasting Stations and their multimedia programmes: e.g.

- www.bbc.co.uk – e.g. Tech Tent, Inside Science, The Science Hour
- www.npr.org/ - e.g. STEM spots

Print- or web-based sections of internationally renowned quality newspapers: e.g.

- The Guardian
- The New York Times
- The Times
- The Washington Post

General English Dictionaries, e.g.

- www.merriam-webster.com/
- en.oxforddictionaries.com
- www.collinsdictionary.com/dictionary/english
- dictionary.cambridge.org/dictionary/english/
- www.leo.org
- www.linguee.de/
- de.pons.com/
- www.dict.cc/
- de.langenscheidt.com/englisch-deutsch/
- www.onelook.com (search engine)

Technology / Engineering / Science - specific dictionaries, e.g.

- https://www.engineering-dictionary.com
- https://www.lexicool.com/online-dictionary.asp?FSP=C153&FKW=engineering
- http://www.dictionary.bi.htwg-konstanz.de/index.php?load=start&lang=en
- https://www.thesciencedictionary.com/
- http://www.worldofscience.in/dictonary.aspx

English Learning Software / Blended-Learning Modules:

- ET - Exam Trainer (in-house development by the Language Centre)
- FFT - Fast Formula Trainer (in-house development by the Language Centre)
- ESP - English Support Programme (in-house development by the Language Centre)
- various E-learning products, tools and further in-house developments

Resources

TECHNICAL ENGLISH – MECHATRONICS/MECHANICAL ENGINEERING

Selected texts developed and provided by the Language Centre or based on reputable online publications

Internet-websites of Technology / Engineering / Science - related magazines, e.g.:

- www.eandt.theiet.org
- www.sciencedaily.com
- www.quantamagazine.org
- www.facilitiesshow.com
- www.scitechdaily.com
- www.techxplore.com/engineering-news/ (formerly: www.phys.org/technology-news/engineering)
- www.theengineer.co.uk
- www.nsf.gov/news/
- www.spectrum.ieee.org
- www.snexplores.org/ (formerly: www.sciencenewsforstudents.org/)
- www.techopedia.com
- www.sciencedirect.com

Web-based tutorials und educational materials, e.g.:

- www.howstuffworks.com
- www.energyeducation.ca/encyclopedia/Wind_turbine
- www.koyo.jtekt.co.jp/en/2019/06/column01-01.html (bearings)
- www.studentenergy.org/map/
- www.energy.gov
- www.energysage.com
- www.sciencing.com
- www.engineerstudent.co.uk/
- www.interestingengineering.com/
- www.techaddu.wordpress.com/
- www.themechanic.weebly.com/
- www.instructables.com/
- www.electricalacademia.com
- www.alternative-energy-tutorials.com/
- www.thegraduateengineer.com
- www.electricalclassroom.com
- www.smartgrid.gov

Various YouTube Channels on topics like:

- maths (e.g. numberphile)
- computation
- vehicle propulsion technology (conventional, fuel cells, battery driven)
- renewable energy (e.g. hydro, solar, wind and wave power)
- robotics
- electrical grid

IT/Multimedia-related (audio-video) podcast sources, e.g.:

- www.thenakedscientists.com
- www.npr.org

International Broadcasting Stations and their multimedia programmes: e.g.:

- www.bbc.co.uk – e.g. Tech Tent, Inside Science, The Science Hour, The Life Scientific
- www.npr.org/ - e.g. STEM spots

Print- or web-based sections of internationally renowned quality newspapers: e.g.:

- The Guardian
- The New York Times
- The Times
- The Washington Post

General English Dictionaries, e.g.:

- www.merriam-webster.com/
- en.oxforddictionaries.com
- www.collinsdictionary.com/dictionary/english
- dictionary.cambridge.org/dictionary/english/
- www.leo.org
- www.linguee.de/
- de.pons.com/
- www.dict.cc/
- de.langenscheidt.com/englisch-deutsch/
- www.onelook.com (search engine)

HIGHER
EDUCATION
ALLIANCE
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Higher Education Alliance Ruhr
Bebelstraße 20
44623 Herne
Germany

hochschulallianz.ruhr/study-here

Hochschule Bochum
Bochum University
of Applied Sciences

Fachhochschule
Dortmund
University of Applied Sciences and Arts

Westfälische
Hochschule
Gelsenkirchen Bocholt Recklinghausen
University of Applied Sciences

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