MODULE HANDBOOK

Bachelor of Engineering

Bachelor Robotics (FS-BAROE)

180 CP

Distance Learning

As of April 23rd, 2024

INTERNATIONAL UNIVERSITY OF APPLIED SCIENCES

Classification: Undergraduate

Contents

1. Semester

Introduction to Robotics

Module Code: DLBROIR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Matthias Eifler (Introduction to Robotics)

Contributing Courses to Module

- Introduction to Robotics (DLBROIR01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam or Written Assessment: Written Assignment, 90 Minutes Study Format: myStudies Exam or Written Assessment: Written Assignment, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Introduction to Robotics
- Trends
- Industrial Robots
- Mobile Robots
- Applications

Learning Outcomes	
Introduction to Robotics On successful completion, students will be able to ▪ name important developments in the field of robotics. ▪ understand the mechanical structure and characteristics of robots. ▪ name characteristics and challenges of industrial robots. ▪ name characteristics and challenges of mobile robots. ▪ understand the role of robots in applications. ▪ name and understand current trends in the field of robotics.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Introduction to Robotics

Course Code: DLBROIR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Robotics is experiencing very interesting developments, which experts describe as being a transition to a new generation of robots. We have moved from the “4Ds” of Robotics 1.0 (dull, dirty, dumb, dangerous) to the “4Ss” of Robotics 2.0 (smarter, safer, sensors, simple), but we still need to proceed further to the “4Ms” of Robotics 3.0 (multitasking, emotive, morphing, multiagent). This course, thus, provides the required background to understand the main development of robotics looking at industrial as well as at mobile robots, their main characteristics, issues, challenges, applications, and development trends.

Course Outcomes

On successful completion, students will be able to

- name important developments in the field of robotics.
- understand the mechanical structure and characteristics of robots.
- name characteristics and challenges of industrial robots.
- name characteristics and challenges of mobile robots.
- understand the role of robots in applications.
- name and understand current trends in the field of robotics.

Contents

1. What is Robotics?
   - 1.1 Basics and Definitions
   - 1.2 History and Cultural Influence
   - 1.3 Challenges and Trends (from Robotics 1.0 to Robotics 3.0)

2. Robots
   - 2.1 Mechanical Structure
   - 2.2 Kinematic Chains
   - 2.3 Market Overview

3. Industrial Robots
   - 3.1 Components of Industrial Robot Systems
   - 3.2 Characteristics

Literature

Compulsory Reading

Further Reading

- Mihelj, M., Bajd, T., Ude, A., Lenarcic, J., Stanovnik, A., Munih, M., Rejc, J., & Slajpah, S. (2019). Robotics(2nd ed.). Springer.
- Ben-Ari, M., & Mondada, F. (2017). Elements of robotics. Springer.
- Siciliano, B., & Khatib, O. (Eds.). (2016). Springer handbook of robotics. Springer

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam or Written Assessment: Written Assignment, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
100 h	0 h	25 h	25 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests ☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam or Written Assessment: Written Assignment, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
100 h	0 h	25 h	25 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	☑ Guideline
	☑ Slides	

Introduction to Academic Work

Module Code: DLBCSIAW

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Brigitte Huber (Introduction to Academic Work)

Contributing Courses to Module

- Introduction to Academic Work (DLBCSIAW01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Basic Workbook (passed / not passed) Study Format: Distance Learning Basic Workbook (passed / not passed)	

Weight of Module

see curriculum

Module Contents

- Scientific Theoretical Foundations and Research Paradigms
- Application of Good Scientific Practice
- Methodology
- Librarianship: Structure, Use, and Literature Management
- Forms of Scientific Work at IU

Learning Outcomes	
Introduction to Academic Work On successful completion, students will be able to ▪ understand and apply formal criteria of a scientific work. ▪ distinguish basic research methods and identify criteria of good scientific practice. ▪ describe central scientific theoretical basics and research paradigms and their effects on scientific research results. ▪ use literature databases, literature administration programs, and other library structures properly; avoid plagiarism; and apply citation styles correctly. ▪ apply the evidence criteria to scientific texts. ▪ define a research topic and derive a structure for scientific texts. ▪ compile a list of literature, illustrations, tables, and abbreviations for scientific texts. ▪ understand and distinguish between the different forms of scientific work at IU.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the Business field

Introduction to Academic Work

Course Code: DLBCSIAW01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The application of good scientific practice is one of the basic academic qualifications that should be acquired while studying. This course deals with the distinction between everyday knowledge and science. This requires a deeper understanding of the theory of science, as well as the knowledge of basic research methods and instruments for writing scientific texts. The students therefore gain initial insight into academic research and are introduced to the basic knowledge that will help them in the future to produce scientific papers. In addition, the students receive an overview of the different IU examination forms and insight into their requirements and implementation.

Course Outcomes

On successful completion, students will be able to

- understand and apply formal criteria of a scientific work.
- distinguish basic research methods and identify criteria of good scientific practice.
- describe central scientific theoretical basics and research paradigms and their effects on scientific research results.
- use literature databases, literature administration programs, and other library structures properly; avoid plagiarism; and apply citation styles correctly.
- apply the evidence criteria to scientific texts.
- define a research topic and derive a structure for scientific texts.
- compile a list of literature, illustrations, tables, and abbreviations for scientific texts.
- understand and distinguish between the different forms of scientific work at IU.

Contents

1. Theory of Science
   - 1.1 Introduction to Science and Research
   - 1.2 Research Paradigms
   - 1.3 Fundamental Research Decisions
   - 1.4 Effects of Scientific Paradigms on Research Design

2. Application of Good Scientific Practice
   - 2.1 Research Ethics
   - 2.2 Evidence Teaching

Literature
Compulsory Reading
Further Reading ▪ Bell, J., & Waters, S. (2018). Doing your research project: A guide for first-time researchers (7th ed.). Open University Press McGraw-Hill Education. ▪ Deb, D., Dey, R., & Balas, V. E. (2019). Engineering research methodology: A practical insight for researchers. Springer. ▪ Saunders, M., Lewis, P., & Thornhill, A. (2019). Research Methods for Business Students (8th ed.). Pearson. ▪ Veal, A. J. (2018). Research Methods for Leisure and Tourism (5th ed.). Pearson.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Basic Workbook (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Online Tests ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Basic Workbook (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Online Tests ☑ Guideline

Mathematics II

Module Code: DLBCSM2

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Robert Graf (Mathematics II)

Contributing Courses to Module
▪ Mathematics II (DLBCSM201)

Module Exam Type	
Module Exam Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents
▪ Selected topics of linear algebra ▪ Selected chapters on graphs and algorithms

Learning Outcomes	
Mathematics II On successful completion, students will be able to ▪ understand basic concepts of linear algebra, their interrelations, and their application in IT and technology and be able solve tasks independently using these concepts. ▪ understand and distinguish the basic concepts and important algorithms for graphs and trees from the field of discrete mathematics as well as their application in IT and technology.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the Business & Management field

Mathematics II

Course Code: DLBCSM201

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course continues the introduction to topics of discrete mathematics which began in the module "Mathematics Fundamentals I". In this course, the concepts of linear algebra are introduced and knowledge about graphs and algorithms for graphs is deepened. Typical questions of applied computer science are selected, and students are shown how they can be solved with graphs.

Course Outcomes

On successful completion, students will be able to

- understand basic concepts of linear algebra, their interrelations, and their application in IT and technology and be able solve tasks independently using these concepts.
- understand and distinguish the basic concepts and important algorithms for graphs and trees from the field of discrete mathematics as well as their application in IT and technology.

Contents

1. Introduction to Matrices
   - 1.1 Basic Concepts of Matrices
   - 1.2 Addition of Matrices
   - 1.3 Scalar Multiplication and Product
2. Inverting Matrices
   - 2.1 Multiplication of Matrices
   - 2.2 Properties of Matrix Multiplication
   - 2.3 Inverse Matrices
3. Linear Systems of Equations
   - 3.1 Gauss Algorithm
   - 3.2 Example Applications of the Gaussian Algorithm
4. Introduction to Graphs
   - 4.1 Undirected Graphs
   - 4.2 Further Properties of Graphs

Literature

Compulsory Reading

Further Reading

- Benjamin, A., Chartrand, G., and Zhang, P. (2017). The fascinating world of graph theory. Princeton University Press.
- Erciyes, J. (2021). Discrete mathematics and graph theory: A concise study companion and guide. Princeton University Press.
- Lewis, H., & Zax, R. (2019). Essential discrete mathematics for computer science. Princeton University Press.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Fundamentals of Physics

Module Code: DLBWINGP_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Christian Magnus (Fundamentals of Physics)

Contributing Courses to Module

- Fundamentals of Physics (DLBWINGP01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Mechanics
- Thermodynamic Basics
- Electricity Theory and Electric Fields
- Vibration Theory
- Optics & Acoustics
- Introduction to Particle Physics

Learning Outcomes	
Fundamentals of Physics On successful completion, students will be able to ▪ explain the basic concepts of mechanics and calculate the quantities of mechanics. ▪ explain the basic concepts of thermodynamics and calculate the quantities of thermodynamics. ▪ apply the physical laws of electricity to electrostatic and magnetic fields. ▪ explain free and forced oscillations and reproduce applications. ▪ explain phenomena of geometrical optics and wave optics. ▪ understand basic concepts of particle physics.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology field

Fundamentals of Physics

Course Code: DLBWINGP01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	None

Course Description

Basic principles of physics form the foundation of many engineering applications. The basic principles of mechanics, thermodynamics, and electricity, for example, are implemented in almost all technical products and are considered in their design. The course provides a broad overview of the fundamentals of physics starting from the axioms of mechanics, thermodynamic principles, electricity theory, vibration theory, optics and acoustics up to modern aspects of physics in the context of atomic physics and nuclear physics. Thus, the course provides students with an overview of the various subfields of physics and an introduction to scientific problem-solving techniques.

Course Outcomes

On successful completion, students will be able to

- explain the basic concepts of mechanics and calculate the quantities of mechanics.
- explain the basic concepts of thermodynamics and calculate the quantities of thermodynamics.
- apply the physical laws of electricity to electrostatic and magnetic fields.
- explain free and forced oscillations and reproduce applications.
- explain phenomena of geometrical optics and wave optics.
- understand basic concepts of particle physics.

Contents

1. Introduction
   - 1.1 Physics Overview
   - 1.2 Physical Quantities and Units
2. Mechanics
   - 2.1 Forces and Mechanics of Rigid Bodies
   - 2.2 Elastostatics
   - 2.3 The Basic Laws of Classical Mechanics
   - 2.4 Kinematics and Kinetics
   - 2.5 Impulse, Work, and Energy
   - 2.6 Fluid Mechanics

Literature
Compulsory Reading
Further Reading ▪ Knight, R. D. (2016). Physics for scientists and engineers : a strategic approach with modern physics. Pearson Education. ▪ Ohanian, H. C., Markert, J. T., & Ohanian, H. C. (2007). Physics for engineers and scientists (3rd ed.). W.W. Norton. ▪ Walker, J., Halliday, D., & Resnick, R. (2020). Halliday & Resnick's Principles of Physics (11th ed.). Wiley.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Review Book ☑ Online Tests

Mathematics: Linear Algebra

Module Code: DLBDSMFLA

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Robert Graf (Mathematics: Linear Algebra)

Contributing Courses to Module

- Mathematics: Linear Algebra (DLBDSMFLA01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Matrix Algebra
- Vector Spaces
- Linear and Affine Transformations
- Analytical Geometry
- Matrix Decomposition

Learning Outcomes	
Mathematics: Linear Algebra On successful completion, students will be able to ▪ explain fundamental notions in the domain of linear equation systems. ▪ exemplify properties of vectors and vector spaces. ▪ summarize characteristics of linear and affine mappings. ▪ identify important relations in analytical geometry. ▪ utilize different methods for matrix decomposition.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the Business & Management field

Mathematics: Linear Algebra

Course Code: DLBDSMFLA01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Linear algebra is a fundamental subject in mathematics. Its historical origin lies in the development of solution techniques for systems of linear equations arising from geometric problems. Numerous scientific and engineering applications can be solved using its methods. This course introduces the foundations of linear algebra and its basic notions like vectors and matrices. It then builds upon this foundation by introducing the derivation of solution techniques for problems in analytical geometry.

Course Outcomes

On successful completion, students will be able to

- explain fundamental notions in the domain of linear equation systems.
- exemplify properties of vectors and vector spaces.
- summarize characteristics of linear and affine mappings.
- identify important relations in analytical geometry.
- utilize different methods for matrix decomposition.

Contents

1. Foundations
   - 1.1 Systems of Linear Equations
   - 1.2 Matrices: Basic Terms
   - 1.3 Matrix algebra
   - 1.4 Matrices as compact representations of linear equations
   - 1.5 Inverse and trace

2. Vector Spaces
   - 2.1 Definition
   - 2.2 Linear Combination and Linear Dependance
   - 2.3 Basis, Linear Envelope, and Rank

3. Linear and Affine Mapping
   - 3.1 Matrix Representation of Linear Mappings
   - 3.2 Image and Kernel

Literature

Compulsory Reading

Further Reading

- Aggarwal, C.C. (2020). Linear Algebra and Optimization for Machine Learning: A Textbook. Springer.
- Mathai, A. M., & Haubold, H. J. (2017). Linear algebra, a course for physicists and engineers (1st ed.) De Gruyter.
- Neri, F. (2019). Linear algebra for computational sciences and engineering (2nd ed.) Springer.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Audio	☑ Online Tests
	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Audio	☑ Online Tests
	☑ Slides	

Technical Drawing

Module Code: DLBROTD_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Hans Kerwat (Technical Drawing)

Contributing Courses to Module

- Technical Drawing (DLBROTD01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Technical drawing
- Descriptive geometry
- Design process
- Technical communication

Learning Outcomes	
Technical Drawing On successful completion, students will be able to ▪ formulate product ideas by creating technical drawings. ▪ read and interpret technical drawings. ▪ analyze design processes. ▪ optimize design processes.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Technical Drawing

Course Code: DLBROTD01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The content of this course focuses on reading, understanding and creating technical drawings. Students will be introduced to the fields of Engineering and Design. In addition, students will acquire basic knowledge in technical drawing and descriptive geometry. In doing so, they learn about the design and development process. The aim of this course is for students to understand the relevance of design in product development. They can analyze problems by reading drawings and will be able to formulate and create product ideas out of them.Technical drawing is the foundation for the description of technical products as well as technical communication and, thus, a basic qualification for engineering work.

Course Outcomes

On successful completion, students will be able to

- formulate product ideas by creating technical drawings.
- read and interpret technical drawings.
- analyze design processes.
- optimize design processes.

Contents

1. Illustration in Technical Drawings
   - 1.1 Sketches (by Hand)
   - 1.2 Axonometric Projection
2. Basics of Technical Drawing
   - 2.1 Types of Drawings
   - 2.2 Drawing Format
3. Views
   - 3.1 Three-Panel Projection
   - 3.2 Projection Methods (1 & 3)
   - 3.3 Cuts/Breakout
4. Dimensioning

Literature

Compulsory Reading

Further Reading

- Henzold, G. (2006). Geometrical dimensioning and tolerancing for design, manufacturing and inspection (2nd ed.). Elsevier.
- Madsen, D. A., & Madsen, D. P. (2016). Engineering drawing and design (6th ed.). Cengage Learning.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

2. Semester

Production Engineering Industry 4.0

Module Code: DLBDSEAR1

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Hans Kerwat (Production Engineering Industry 4.0)

Contributing Courses to Module

- Production Engineering Industry 4.0 (DLBDSEAR01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Introduction to Manufacturing Technology
- Main Production Groups According to DIN 8580
- Additive Manufacturing Processes
- Rapid Prototyping
- Rapid Tooling
- Direct/Rapid Manufacturing
- Cyber-Physical Production Plants

Learning Outcomes	
Production Engineering Industry 4.0 On successful completion, students will be able to ▪ understand the basic concepts and interrelationships of production engineering. ▪ understand current changes in manufacturing technology due to technologies such as additive manufacturing and megatrends such as cyber physical systems. ▪ assign different manufacturing processes to the main manufacturing groups according to DIN 8580. ▪ understand the basic principle of additive manufacturing processes. ▪ distinguish between different additive manufacturing processes. ▪ understand the terms Rapid Prototyping, Rapid Tooling, and Direct Manufacturing and name individual processes and application examples. ▪ understand the elements and properties of cyber-physical production plants.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology fields

Production Engineering Industry 4.0

Course Code: DLBDSEAR01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The aim of the course is to provide students with an overview of the processes that have influenced and still influence production processes through technological developments under the generic term Industry 4.0, based on traditional, standardized manufacturing techniques. These include, in particular, technological advances in additive manufacturing processes that enable applications such as rapid prototyping, rapid tooling, and direct manufacturing. Finally, the course deals with the consequences of the digitalization and networking of production facilities and their elements in the sense of a cyber-physical system.

Course Outcomes

On successful completion, students will be able to

- understand the basic concepts and interrelationships of production engineering.
- understand current changes in manufacturing technology due to technologies such as additive manufacturing and megatrends such as cyber physical systems.
- assign different manufacturing processes to the main manufacturing groups according to DIN 8580.
- understand the basic principle of additive manufacturing processes.
- distinguish between different additive manufacturing processes.
- understand the terms Rapid Prototyping, Rapid Tooling, and Direct Manufacturing and name individual processes and application examples.
- understand the elements and properties of cyber-physical production plants.

Contents

1. Introduction to Manufacturing Technology
   - 1.1 Basic Terms and Contexts in Manufacturing Theory
   - 1.2 Historical Development of Production
   - 1.3 The Discussion About the Long Tail

2. Classification Of Manufacturing Processes
   - 2.1 Casting and Molding
   - 2.2 Forming
   - 2.3 Machining
   - 2.4 Joining

Literature
Compulsory Reading
Further Reading ▪ Anderson, C. (2012). Makers: The new industrial revolution. Crown Business. ▪ Gebhardt, A., Kessler, J. & Thurn, L. (2019). 3D printing: Understanding additive manufacturing (2nd ed). Hanser. ▪ Groover, M. P. (2012). Fundamentals of modern manufacturing: Materials, processes, and systems (5th ed.). Wiley.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Introduction to Programming with Python

Module Code: DLBDSIPWP

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Cosmina Croitoru (Introduction to Programming with Python)

Contributing Courses to Module

- Introduction to Programming with Python (DLBDSIPWP01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes Study Format: On Campus Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Python as a programming language for data science
- Variables and built-in datatypes
- Statements and functions
- Error and exception handling
- Important Python data science modules

Learning Outcomes	
Introduction to Programming with Python On successful completion, students will be able to ▪ use fundamental Python syntax. ▪ recollect common elementary data types. ▪ recognize foundational programming concepts and their realization in Python. ▪ understand error handling and logging. ▪ create working programs. ▪ list the most important libraries and packages for data science.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Introduction to Programming with Python

Course Code: DLBDSIPWP01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course provides students with a foundational understanding of the Python programming language. Following an introductory exposition to the importance of Python for data science-related programming tasks, students will be acquainted with fundamental programming concepts like variables, data types, and statements. Building on this basis, the important notion of a function is explained and errors, exception handling, and logging are explicated. The course concludes with an overview of the most widely-used library packages for data science.

Course Outcomes

On successful completion, students will be able to

- use fundamental Python syntax.
- recollect common elementary data types.
- recognize foundational programming concepts and their realization in Python.
- understand error handling and logging.
- create working programs.
- list the most important libraries and packages for data science.

Contents

1. Introduction
   - 1.1 Why Python?
   - 1.2 Obtaining and installing Python
   - 1.3 The Python interpreter , IPython, and Jupyter

2. Variables and Data Types
   - 2.1 Variables and value assignment
   - 2.2 Numbers
   - 2.3 Strings
   - 2.4 Collections
   - 2.5 Files

3. Statements
   - 3.1 Assignment, expressions, and print

3.2 Conditional statements
3.3 Loops
3.4 Iterators and comprehensions

4. Functions
4.1 Function declaration
4.2 Scope
4.3 Arguments

5. Errors and Exceptions
5.1 Errors
5.2 Exception handling
5.3 Logs

6. Modules and Packages
6.1 Usage
6.2 Namespaces
6.3 Documentation
6.4 Popular data science packages

Literature

Compulsory Reading

Further Reading

- Barry, P. (2016). Head first Python: A brain-friendly guide. Sebastopol, CA: O'Reilly Media, Inc.
- Kapil, S. (2019). Clean Python: Elegant coding in Python. Berkeley, CA: Apress.
- Lubanovic, B. (2019). Introducing Python (2nd ed.). Sebastopol, CA: O’Reilly.
- Lutz, M. (2013). Learning Python (5th ed.). Sebastopol, CA: O’Reilly.
- Matthes, E. (2015). Python crash course: A hands-on, project-based introduction to programming. San Fransisco, CA: No Starch Press.
- Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: A guide for data scientists. Sebastopol, CA: O'Reilly Media, Inc.
- Ramalho, L. (2015). Fluent Python: Clear, concise, and effective programming. Sebastopol, CA: O’Reilly.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format On Campus

Study Format	Course Type
On Campus	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Mathematics: Analysis

Module Code: DLBDSMFC

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Robert Graf (Mathematics: Analysis)

Contributing Courses to Module
▪ Mathematics: Analysis (DLBDSMFC01)

Module Exam Type	
Module Exam Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents
▪ Sequences and series ▪ Functions & reverse functions ▪ differential calculus ▪ integral calculus

Learning Outcomes	
Mathematics: Analysis On successful completion, students will be able to ▪ summarize the basic concepts of analysis. ▪ illustrate the terms "consequences" and "series". ▪ explain the concept of function and to understand the concept of the inverse function. ▪ explain basic statements of the differential and integral calculus. ▪ explain the relationship between differentiation and integration. ▪ master the derivation of higher-dimensional functions.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Methods	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Mathematics: Analysis

Course Code: DLBDSMFC01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Analysis is one of the essential basic subjects of mathematics. Originally developed to be able to formulate and solve problems of classical mechanics mathematically, in its present rigorous form it has become indispensable in numerous applications in the natural sciences and technology. This module aims to introduce the basic hand tool of differential and integral calculus and to explain their mutual interrelations. In addition, the differential calculus is generalized to multidimensional spaces.

Course Outcomes

On successful completion, students will be able to

- summarize the basic concepts of analysis.
- illustrate the terms "consequences" and "series".
- explain the concept of function and to understand the concept of the inverse function.
- explain basic statements of the differential and integral calculus.
- explain the relationship between differentiation and integration.
- master the derivation of higher-dimensional functions.

Contents

1. Sequences and series
   - 1.1 Sequences and series
   - 1.2 Convergence of infinite series
   - 1.3 power series

2. Functions and reverse functions
   - 2.1 Continuous functions
   - 2.2 Exponential and logarithm function
   - 2.3 Trigonometric functions and their inverse functions

3. Differential calculus
   - 3.1 Derivatives and higher derivatives
   - 3.2 curve discussion
   - 3.3 Rules (chain rule, product rule, quotient rule ...)

3.4 Taylor Rows

4. Integral calculus
   4.1 The Riemann Integral
   4.2 Specific and indefinite integrals
   4.3 The fundamental theorem of differential and integral calculus
   4.4 Volumes and shells of rotary bodies
   4.5 Paths and lengths

5. Differential calculus in the Rn
   5.1 Partial Derivation
   5.2 Total Derivation
   5.3 Gradients of vector-valued functions and matrices

Literature

Compulsory Reading

Further Reading

- Deisenroth, M.P., Faisal, A.A., & Ong, C.S. (2020). Mathematics for Machine Learning. Cambridge University Press.
- Magnus, R. (2020). Fundamental Mathematical Analysis. Springer International Publishing.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
☑ Recorded Live Sessions	☑ Audio	☑ Online Tests
	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Review Book ☑ Online Tests

Mechanics - Statics

Module Code: DLBROMS_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Moritz Venschott (Mechanics - Statics)

Contributing Courses to Module

- Mechanics - Statics (DLBROMS01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Bearing reactions
- Balance conditions
- Determinancy
- Structure
- Mechanics

Learning Outcomes	
Mechanics - Statics On successful completion, students will be able to ▪ calculate bearing reactions. ▪ describe the most important terms of statics and the static determination of systems. ▪ understand the importance of systems of forces on supporting structures. ▪ describe and calculate static processes through balance conditions. ▪ determine balance points.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Mechanics - Statics

Course Code: DLBROMS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, participants will get an overview of the importance of systems of forces, frameworks and supporting structures and learn the basics of their calculation and corresponding methods.Students will learn to transform technical systems into suitable mechanical replacement models. Further, using balance conditions, students will be able to specify a complete load state on rigid systems by means of clearance cutting. Students can independently check systems for static determination. They can independently calculate bar forces of planar frameworks following diverse methods. Furthermore, students are able to calculate inner component load of simple mechanical systems by means of internal force variables. They can interpret stress values and independently evaluate the component load. Finally, limitations in rigid body statics are discussed.

Course Outcomes

On successful completion, students will be able to

- calculate bearing reactions.
- describe the most important terms of statics and the static determination of systems.
- understand the importance of systems of forces on supporting structures.
- describe and calculate static processes through balance conditions.
- determine balance points.

Contents

1. Basic Physical Quantities, Vectors
   - 1.1 Physical Quantities, Units
   - 1.2 Newton’s Basic Axioms
   - 1.3 Scalars, Position and Force Vectors
   - 1.4 Vector Operations

2. Static Equilibrium
   - 2.1 Equilibrium of Particles
   - 2.2 Moment
   - 2.3 Center of Gravity
   - 2.4 Equilibrium of Rigid Bodies

2.5 Bearing Types, Static Determinacy

3. Planar Trusses
   - 3.1 Simple Triangular Trusses
   - 3.2 Analysis Using Methods of Joints
   - 3.3 Analysis Using Method of Sections
   - 3.4 The Principle of Virtual Work

4. Internal Forces
   - 4.1 Center of Areas, Moment of Inertia
   - 4.2 Beam Internal Loading
   - 4.3 Beams with Different Support Conditions

5. Solid State Friction
   - 5.1 Static Friction
   - 5.2 Sliding Friction
   - 5.3 Rolling Friction

Literature

Compulsory Reading

Further Reading

- Beer, F., Johnston. E., & Mazurek, D. (2019). Vector mechanics for engineers: Statics (12th ed.).McGraw Hill.
- Gross, D., Hauger, W., Schröder, J., Wall, W.A., & Rajapakse, N. (2013). Engineering mechanics 1,statics (2nd ed.). Springer.
- Hibbeler, R.C. (2016). Engineering mechanics: Statics (14th ed.). Pearson Prentice Hall.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
	☑ Audio	☑ Online Tests
	☑ Slides	

Electrical Engineering

Module Code: DLBINGET-01_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Dr. Maedeh Ranjbar-Zefreh (Electrical Engineering)

Contributing Courses to Module
▪ Electrical Engineering (DLBINGET01-01_E)

Module Exam Type	
Module Exam Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents	
▪ Basic Terms ▪ Introduction to Direct Current Technology ▪ Calculation of Direct Current Networks ▪ Electric Fields ▪ Introduction to Alternating Current Technology ▪ Calculation of Alternating Current Networks ▪ Locus Curves ▪ Transformers ▪ Multiphase Systems ▪ Transient Response	
Learning Outcomes **Electrical Engineering** On successful completion, students will be able to ▪ know the basic terms of electrical engineering. ▪ calculate DC (direct current) circuits and networks. ▪ know the different types of electrical fields. ▪ calculate AC (alternating current) circuits and networks. ▪ know methods for the construction of root locus curves. ▪ know the basic structure of different types of transformers. ▪ calculate equivalent circuit diagrams with transformers. ▪ know multiphase systems and can distinguish them from single-phase systems. ▪ measure performance in a three-phase system. ▪ calculate the transient response with the Laplace transformation.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Engineering	**Links to other Study Programs of the University** All Bachelor Programmes in the IT & Technology fields

Electrical Engineering

Course Code: DLBINGET01-01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description
The aim of the course is to offer students a broad insight into the basics of electrical engineering. First of all, the basic terms of electrical engineering and the relevant physical quantities are introduced. This is followed by two comprehensive sectionson direct current and alternating current technology. They are first briefly introduced using their essential elements and properties and then supplemented by methods for calculating the respective circuits and networks. Based on this, multi-phase systems and their application in public power supply are presented. The course concludes with a consideration of the transient response and its calculation using the Laplace transformation.

Course Outcomes

On successful completion, students will be able to

- know the basic terms of electrical engineering.
- calculate DC (direct current) circuits and networks.
- know the different types of electrical fields.
- calculate AC (alternating current) circuits and networks.
- know methods for the construction of root locus curves.
- know the basic structure of different types of transformers.
- calculate equivalent circuit diagrams with transformers.
- know multiphase systems and can distinguish them from single-phase systems.
- measure performance in a three-phase system.
- calculate the transient response with the Laplace transformation.

Contents

1. Basic Terms
   - 1.1 Charge, Electric Fields and Voltage
   - 1.2 Current and Resistance
   - 1.3 Electrical Energy and Power

2. Introduction to Direct Current Technology
   - 2.1 Kirchhoff's Laws
   - 2.2 Calculation of Series and Parallel Connections
   - 2.3 Voltage and Current Divider Rule

3. Calculation of Direct Current Networks
   - 3.1 Mesh-Current and Node-Voltage Method
   - 3.2 Superposition Method
   - 3.3 Wye-Delta Transformation of Circuits
   - 3.4 Examples

4. Introduction to Alternating Current Technology
   - 4.1 Electrostatic and Magnetic Fields
   - 4.2 Capacitor and Inductor
   - 4.3 Alternating Variables and their Calculation
   - 4.4 Network Analysis with Complex-Valued Variables

5. Calculation of Alternating Current Networks
   - 5.1 Simple AC Circuits and their Calculation
   - 5.2 Power Types in the AC Circuit
   - 5.3 Oscillating Circuits
   - 5.4 Examples

6. Root Locus Curves
   - 6.1 The Root Locus Concept
   - 6.2 Construction of Various Root Locus Curves
   - 6.3 Examples

7. Transformers
   - 7.1 Basic Functionality
   - 7.2 Equivalent Circuit Diagram
   - 7.3 Measurement Methods

8. Multiphase Systems
   - 8.1 Three-Phase Current Technology (Three-Phase Systems)
   - 8.2 Power Measurement in Three-Phase Systems

9. Transient Response
   - 9.1 Description of Time Dependent Processes with Differential Equations
   - 9.2 Setting up Differential Equations of Electrical Circuits
   - 9.3 Introduction to the Laplace Transformation
   - 9.4 Calculation of Transient Response

Literature
Compulsory Reading
Further Reading

- Dossis, N. (2013). Basic electronics for tomorrow’s inventors. McGraw-Hill.
- Herrick, C. N. (1997). Basic electronics math. Newnes.
- Nilsson, J. W. & Riedel, S. (2019). Electric circuits (11th ed.). Pearson.
- Narayana Rao, B. Y., & Anand, K. (2010). Electronics. Himalaya Publishing House.
- Tayal, D. C. (2010). Basic electronics. Himalaya Publishing House.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
	☑ Video	☑ Review Book
	☑ Audio	☑ Online Tests
	☑ Slides	

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Review Book ☑ Online Tests

Project: Design with CAD

Module Code: DLBROPDCAD_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBROTD01_E	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Christian Magnus (Project: Design with CAD)

Contributing Courses to Module
▪ Project: Design with CAD (DLBROPDCAD01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Oral Project Report	**Split Exam**
Weight of Module see curriculum	

Module Contents
In this design project students will apply their acquired skills by means of Computer Aided Design (CAD).

Learning Outcomes	
Project: Design with CAD On successful completion, students will be able to ▪ create complex components in CAD. ▪ design components. ▪ create assemblies. ▪ review assembly and functionality (Digital Twin).	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Project: Design with CAD

Course Code: DLBROPDCAD01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBROTD01_E

Course Description

Participants of this course have already acquired knowledge of basic contents of computer-aided design. This course is intended to help consolidate what has been learned from brainstorming over conceptualizing to practical application.Through the application of practical exercises using CAD, students connect and implement the modules of a CAD process chain and their individual functions. In this way, students gain an insight into the problems frequently encountered in the practice of engineering.

Course Outcomes

On successful completion, students will be able to

- create complex components in CAD.
- design components.
- create assemblies.
- review assembly and functionality (Digital Twin).

Contents

- In this course students develop their own design ideas from scratch. A task with certain conditions is assigned, on the basis of which students will develop their mechanical design. For this purpose, students will use these common methods of mechanical design.
    - Creation of a requirement and specification sheet
    - brainstorming (e.g. morphological box/pairwise comparison/utility analysis)
    - design in CAD
    - Documentation in the form of a technical report

Literature
Compulsory Reading
Further Reading

- Haberhauer, H./Bodenstein, F. (2014): Maschinenelemente. Gestaltung, Berechnung, Anwendung. 17. Auflage, Springer Vieweg, Berlin.
- Niemann, G. et al. (2019): Maschinenelemente 1. Konstruktion und Berechnung von Verbindungen, Lagern, Wellen. 5. Auflage, Springer Vieweg, Berlin.
- Niemann, G./Neumann, B./Winter, H. (1983): Maschinenelemente. Band 3. 2. Auflage, Springer-Verlag, Berlin.
- Niemann, G./Winter, H. (2003): Maschinenelemente. Band 2. Getriebe allgemein, Zahnradgetriebe – Grundlagen, Stirnradgetriebe. 2. Auflage, Springer, Berlin.
- Rieg, F./Steinhilper, R. (2018): Handbuch Konstruktion. 2. Auflage, Carl Hanser, München.
- Schlecht, B. (2009): Maschinenelemente 2. 2. Auflage, Pearson Verlag, München.
- Schlecht, B. (2015): Maschinenelemente 1. 2., aktualisierte Auflage, Pearson Verlag, München.
- Vajna, S. et al. (2018): CAx für Ingenieure. Eine praxisbezogene Einführung. 3. Auflage, Springer Vieweg, Wiesbaden.
- Wittel, H. et al. (2013): Roloff/Matek. Maschinenelemente. 21. Auflage, Springer Vieweg, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

3. Semester

Sensor Technology

Module Code: DLBROST_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Matthias Eifler (Sensor Technology)

Contributing Courses to Module
▪ Sensor Technology (DLBROST01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes Study Format: myStudies Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Sensors and transducers
- Resistive, capacitive, inductive, optical and acoustic sensor effects
- Transduction platforms and sensor systems
- Applications
- Advanced sensors

Learning Outcomes	
Sensor Technology On successful completion, students will be able to ▪ understand the main sensor characteristics. ▪ read and understand a typical sensor data sheet. ▪ understand sensor effects. ▪ understand and characterize sensor platforms. ▪ select the appropriate sensor technology for a given application.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Sensor Technology

Course Code: DLBROST01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Sensors are at the base of any modern engineering system, for example, control systems in robotics. This course provides the basic knowledge to understand sensors and their characteristics. A specific sensor is chosen for an application mainly based on its characteristics and on its physical effect. After an introduction on sensors and types of sensors, this course introduces the main characteristics such as accuracy, precision, resolution, sensitivity, linearity, static and dynamic properties. The second part of the course details the main sensor effects and shows how sensor systems can be built based on such effects and used in engineering applications. The last part of the course shows current trends and advanced applications of sensor technology.

Course Outcomes

On successful completion, students will be able to

- understand the main sensor characteristics.
- read and understand a typical sensor data sheet.
- understand sensor effects.
- understand and characterize sensor platforms.
- select the appropriate sensor technology for a given application.

Contents

1. Introduction to Measurement Uncertainty
   - 1.1 Measurement Uncertainty
   - 1.2 Confidence Intervals
   - 1.3 Expression of Uncertainty
2. Sensors
   - 2.1 Sensors and Transducers
   - 2.2 Selection of Sensors
   - 2.3 Sensor Characteristics
   - 2.4 Measurement Systems and Components
3. Resistive Sensors
   - 3.1 Resistivity and Resistance

Literature
Compulsory Reading
Further Reading ▪ Dertien, E., & Regtien, P. (2018). Sensors for mechatronics (2nd ed.). Elsevier. ▪ Lin, Y. L., Kyung, C. M., Yasuura, H., & Liu, Y. (Eds.) (2015). Smart sensors and systems. Springer International.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Signals and Systems

Module Code: DLBROSS_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Andrej Keksel (Signals and Systems)

Contributing Courses to Module

- Signals and Systems (DLBROSS01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Introduction to systems and signals
- Time-domain analysis of continuous-time systems
- Continuous-time system analysis using the Laplace Transform
- Continuous-time signal analysis: The Fourier Series and the Fourier Transform
- Sampling

Learning Outcomes	
Signals and Systems On successful completion, students will be able to ▪ classify systems and signals. ▪ analyze properties and solve problems involving systems and inputs. ▪ use the Laplace Transform to analyze linear time-invariant systems. ▪ apply the Fourier Series and Fourier Transform to analyze periodic and aperiodic signals. ▪ calculate measures of systems and signals, e.g. signal energy. ▪ understand sampling.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Signals and Systems

Course Code: DLBROSS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

From a mathematical perspective almost everything can be seen and analyzed as being a system, i.e. a unit that processes signals and information and generates signals and information. This course provides the mathematical basics on signals and systems, with a particular emphasis on continuous time. In the first part, the mathematical preliminaries are given, and a classification of signals and systems is presented. The time-domain analysis is introduced, discussing how systems respond to external inputs and their internal conditions. To analyze systems and signals, however, further tools such as the Laplace Transform and the Fourier Series and Transform are widely implemented, because they give useful insights, especially into frequency behavior. The bridge between continuous-time and discrete time systems and signals, i.e. sampling, is also discussed.

Course Outcomes

On successful completion, students will be able to

- classify systems and signals.
- analyze properties and solve problems involving systems and inputs.
- use the Laplace Transform to analyze linear time-invariant systems.
- apply the Fourier Series and Fourier Transform to analyze periodic and aperiodic signals.
- calculate measures of systems and signals, e.g. signal energy.
- understand sampling.

Contents

1. Introduction to Systems and Signals
   - 1.1 Classification of Signals
   - 1.2 Signal Operations
   - 1.3 Classification of Systems
   - 1.4 System Models

2. Time-Domain Analysis of Continuous-Time Systems
   - 2.1 System Response to Internal Conditions and External Input
   - 2.2 System Stability

3. Continuous-Time System Analysis Using the Laplace Transform
   - 3.1 The Laplace Transform

3.2 The Inverse Laplace Transform
3.3 Solution of Differential Equations
3.4 Block Diagrams
3.5 Applications to Systems

4. Continuous-Time Signal Analysis: The Fourier Series and The Fourier Transform
4.1 The Fourier Series
4.2 The Fourier Transform
4.3 Properties
4.4 Signal Energy
4.5 Applications

5. Sampling
5.1 The Discrete-time Fourier Transform and the Sampling Theorem
5.2 Signal Reconstruction
5.3 Analog to Digital Conversion
5.4 Spectral Sampling
5.5 An Introduction to the Discrete and Fast Fourier Transforms

Literature

Compulsory Reading

Further Reading

- Oppenheim, A., Wilsky, A., & Hamid, S. (2013). Signals and systems: Pearson new internationaledition (2nd ed.). Pearson.
- Sadiku, M. N. O., & Ali, W. H. (2020). Signals and systems: A primer with Matlab. CRC Press.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Review Book ☑ Online Tests

Mechanics - Kinematics

Module Code: DLBROMK_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Gabriele Bleser-Taetz (Mechanics - Kinematics)

Contributing Courses to Module

- Mechanics - Kinematics (DLBROMK01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Motion of Rigid Bodies
- Direct Kinematics
- Inverse Kinematics
- Differential Kinematics

Learning Outcomes	
Mechanics - Kinematics On successful completion, students will be able to ▪ understand and describe the motion of rigid bodies. ▪ understand and calculate the direct and inverse kinematic of typical robotic structures. ▪ calculate the differential kinematics of typical robotic structures .	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Mechanics - Kinematics

Course Code: DLBROMK01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The word robot denotes a high variety of mechanical structures ranging from anthropomorphic industrial robots, to robots which mimic animals. This course provides the necessary preliminary background to develop, analyze, model, and simulate mechanical robotic structures of any kind from the viewpoint of the kinematics, i.e., neglecting forces and torques. The first part introduces the kinematics, i.e., a way to describe a robot as a kinematic chain of rigid bodies, which is important to represent position and orientation of the robotic end-effector in the operational space as function of each joint variable. The differential kinematics gives the relationship between joint velocities and corresponding velocity of the end-effector. The important problem of inverse kinematics, unavoidable when designing trajectories of the robot, is also discussed and methods for solutions are presented.

Course Outcomes

On successful completion, students will be able to

- understand and describe the motion of rigid bodies.
- understand and calculate the direct and inverse kinematic of typical robotic structures.
- calculate the differential kinematics of typical robotic structures .

Contents

1. Introduction
   - 1.1 Configuration Space
   - 1.2 Degrees of Freedom
   - 1.3 Topology
   - 1.4 Task Space and Workspace
2. Rigid Body Motions
   - 2.1 Pose of a Rigid Body
   - 2.2 Representations of Orientation
   - 2.3 Homogeneous Transformations
   - 2.4 Exponential Coordinate Representation
3. Forward Kinematics

3.1 The Denavit-Hartenberg Convention
3.2 Product of Exponentials
3.3 The Universal Robot Description Format (URDF)

4. Inverse Kinematics
4.1 Analytical Inverse Kinematics
4.2 Numerical Inverse Kinematics

5. Differential Kinematics and Statics
5.1 Manipulator Jacobian
5.2 Kinematic Singularities
5.3 Manipulability Ellipsoids
5.4 Inverse Differential Kinematics
5.5 Statics

6. Trajectory Planning
6.1 Basic Concepts
6.2 Trajectories in the Joint Space
6.3 Trajectories in the Workspace

Literature

Compulsory Reading

Further Reading

- Lynch, K. M., & Park, F. C. (2017). Modern robotics: Mechanics, planning, and control. Cambridge University Press.
- Siciliano, B., Sciavicco, L., Villani, L., & Oriolo, G. (2009). Robotics: Modelling, planning and control. Springer Science & Business Media.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Review Book ☑ Online Tests

Mechanics - Dynamics

Module Code: DLBROMD_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBROMK01_E	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Maedeh Ranjbar-Zefreh (Mechanics - Dynamics)

Contributing Courses to Module

- Mechanics - Dynamics (DLBROMD01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Dynamics of Rigid Bodies
- Typical Joint Actuators
- Direct Dynamics
- Inverse Dynamics

Learning Outcomes	
Mechanics - Dynamics On successful completion, students will be able to ▪ to understand the dynamics of rigid bodies and the basic physical laws. ▪ to model the dynamics of robots based on the Lagrange and Newton approaches. ▪ to establish dynamic equations for the design, optimization, analysis of robots. ▪ to understand how robot control based on a dynamic model can be realized.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Mechanics - Dynamics

Course Code: DLBROMD01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBROMK01_E

Course Description

The kinematics of a robot allows describing the position and orientation (the pose) of the end-effector based on the joint variables. The presence of forces and torques, i.e., the dynamics of the motion, is completely neglected. The dynamics relates joint variables' velocities and accelerations to the forces and toques acting on the robot. This course introduces the dynamics of rigid bodies and how it can be described mathematically to be used in models, for instance for simulation purposes. The course then introduces two approaches to describe the dynamics of robots, namely the Euler-Lagrange approach and the Newton-Euler one. The Newton-Euler approach yields an iterative algorithm which can be implemented in an efficient way and can be used to calculate necessary torques to achieve required motion dynamics. The necessary torques are the input to various actuating mechanism which must be considered in the overall dynamics. This course shows how to consider the presence of DC motors and gearings in the dynamic model. Finally, the main aspects relating dynamics and control are discussed briefly.

Course Outcomes

On successful completion, students will be able to

- to understand the dynamics of rigid bodies and the basic physical laws.
- to model the dynamics of robots based on the Lagrange and Newton approaches.
- to establish dynamic equations for the design, optimization, analysis of robots.
- to understand how robot control based on a dynamic model can be realized.

Contents

1. Basics
   - 1.1 Dynamics of a Rigid Body
   - 1.2 Classical Formulation
   - 1.3 Twist-Wrench Formulation

2. Lagrange Formulation
   - 2.1 Preliminaries
   - 2.2 General Formulation
   - 2.3 Properties
   - 2.4 Understanding the Dynamic Model

3. Newton-Euler Formulation
    3.1 Link Acceleration
    3.2 Recursive Algorithm

4. Forward and Inverse Dynamics
    4.1 Basic Concepts
    4.2 Forward Dyanamics for Open Chains
    4.3 Newton-Euler Inverse Dynamics
    4.4 Dynamics in the Task Space
    4.5 Constrained Dynamics
    4.6 Robot Dynamics in the Universal Robot Description Framework

5. Actuation
    5.1 DC Motors and Gearings
    5.2 Friction
    5.3 Joint and Link Flexibility

6. Introduction to Motion Control
    6.1 The Control Problem
    6.2 Control in the Joint Space
    6.3 Control in the Operational Space

Literature

Compulsory Reading

Further Reading

- Corke, P. (2017). Robotics, vision, and control: Fundamental algorithms in MATLAB (2nded.). Springer.
- Kurdila, A. J., & Ben-Tzvi, P. (2019). Dynamics and control of robotic systems. Wiley.
- Siciliano, B., & Khatib, O. (Eds.) (2016). Springer handbook of robotics. Springer.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
	☑ Audio	☑ Online Tests
	☑ Slides	

Collaborative Work

Module Code: DLBCSCW

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Karin Halbritter (Collaborative Work)

Contributing Courses to Module

- Collaborative Work (DLBCSCW01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Oral Assignment Study Format: Duales myStudium Oral Assignment Study Format: Distance Learning Oral Assignment	

Weight of Module

see curriculum

Module Contents
▪ Self-Directed and Collaborative Learning ▪ Networking and Cooperation ▪ Performance in (Virtual) Teams ▪ Communication, Arguments, and Being Convincing ▪ Potentials for Conflict and Managing Conflicts ▪ Self-Management and Personal Skills

Learning Outcomes
Collaborative Work On successful completion, students will be able to ▪ design their own learning processes both self-directed and collaborative with analog and digital media. ▪ initiate face-to-face and virtual cooperation and select suitable methods for shaping collaboration even in an intercultural context and across disciplinary boundaries. ▪ assess different forms of communication in relation to the goals and requirements of different situations and to reflect on their own communication and argumentation behavior in order to be able to shape conducive collaboration also in an interdisciplinary context. ▪ recognize social diversity including cultural and professional differences as a value, and to name and apply tools to deal with them constructively. ▪ explain conflict potentials and the role of emotions in conflicts and to describe the use of systemic methods in the target- and solution-oriented handling of conflicts. ▪ analyze one's own resources, present methods of self-leadership and self-motivation, and derive appropriate strategies.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Business Administration & Management	All Bachelor Programs in the Business field

Collaborative Work

Course Code: DLBCSCW01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The course supports the students in building up and expanding important interdisciplinary competences for our networked world, and in doing so, students can take advantage of the opportunities for constructive cooperation with others. It presents essential forms and design possibilities of collaborative learning and working, imparts basic knowledge and tools for self-managed, flexible, and creative thinking, learning and acting and familiarizes students with the topics of empathy and emotional intelligence. Students are also encouraged to use the course contents. In this way, they promote their autonomous competence to act and their competence in the interactive application of tools and in interacting in heterogeneous groups.

Course Outcomes

On successful completion, students will be able to

- design their own learning processes both self-directed and collaborative with analog and digital media.
- initiate face-to-face and virtual cooperation and select suitable methods for shaping collaboration even in an intercultural context and across disciplinary boundaries.
- assess different forms of communication in relation to the goals and requirements of different situations and to reflect on their own communication and argumentation behavior in order to be able to shape conducive collaboration also in an interdisciplinary context.
- recognize social diversity including cultural and professional differences as a value, and to name and apply tools to deal with them constructively.
- explain conflict potentials and the role of emotions in conflicts and to describe the use of systemic methods in the target- and solution-oriented handling of conflicts.
- analyze one's own resources, present methods of self-leadership and self-motivation, and derive appropriate strategies.

Contents

1. Learning for a Networked World, in a Networked World
   - 1.1 Requirements and Opportunities in the “VUCA” World
   - 1.2 Learning, Knowing and Not-Knowing
   - 1.3 The 4C Model: Collective, Collaborative, Continuous, and Connected
   - 1.4 Monitoring Learning Behaviour

Literature
Compulsory Reading
Further Reading ▪ Baber, A., Waymon, L., Alphonso, A., & Wylde, J. (2015). Strategic connections: The new face of networking in a collaborative world. AMACOM. ▪ Kaats, E., & Opheij, W. (2014). Creating conditions for promising collaboration: Alliances, networks, chains, strategic partnerships. Springer. ▪ Martin, S. J., Goldstein, N. J., & Cialdini, R. B. (2014). The small BIG: Small changes that spark BIG influence. Profile Books. ▪ Oettingen, G. (2014). Rethinking positive thinking: Inside the new science of motivation. Current.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Oral Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions		

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Oral Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions		

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Oral Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video	**Exam Preparation** ☑ Online Tests ☑ Guideline

Programming with C/C++

Module Code: DLBROEPRS1_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Dr. Hajck Karapetjan (Programming with C/C++)

Contributing Courses to Module
▪ Programming with C/C++ (DLBROEPRS01_E)

Module Exam Type	
Module Exam Study Format: myStudies Portfolio Study Format: Distance Learning Portfolio	**Split Exam**
Weight of Module see curriculum	

Module Contents
▪ C and C++ for programming of applications and robots

Learning Outcomes	
Programming with C/C++ On successful completion, students will be able to ▪ know the main characteristics of C and C++ programming languages. ▪ apply C and C++ for programming of applications. ▪ apply C and C++ for programming of robotic systems.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the fields of Computer Science & Software Development	All Bachelor Programmes in the IT & Technology fields

Programming with C/C++

Course Code: DLBROEPRS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

C and C++ belong to the class of programming languages which have been adopted in a broad field of applications, ranging from embedded systems (where they are dominant) to fast and reliable user interfaces and industrial applications. In fact, C++ is one of the most popular legacy programming languages for robotics, and a combination of C++ and robotics hardware is used in many leading industries. Knowledge on how to design in and write C/C++ code is an imperative capability for the practicing roboticist, especially in the industrial arena.

Course Outcomes

On successful completion, students will be able to

- know the main characteristics of C and C++ programming languages.
- apply C and C++ for programming of applications.
- apply C and C++ for programming of robotic systems.

Contents

- This course introduces the main aspects of C and C++ programming languages, such as data types, variables, arithmetic expressions, flow control, functions, classes, arrays, and pointers. The programming skills will then be applied to design parts of robotic systems based on popular hardware.

Literature

Compulsory Reading

Further Reading

- Kernighan, B. W. & Ritchie, D. M. (2000). The C Programming Language, Second Edition. Pearson Education.
- Lippman, S. B., Lajoie, J., Moo, B. (2012). C++ Primer, Fifth Edition. Addison Wesley.
- Margolis, M. (2011). Arduino Cookbook. O'Reilly Media.
- Dogan, I. (2021). Nucleo Boards Programming with the STM32CubeIDE. Elektor.

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Slides	☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

4. Semester

Mechatronic Systems

Module Code: DLBROMSY_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Torsten Bruns (Mechatronic Systems)

Contributing Courses to Module

- Mechatronic Systems (DLBROMSY01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Exam, 90 Minutes Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Modeling
- Electrical drives
- Machines and drivetrains
- Actuators and sensors

Learning Outcomes	
Mechatronic Systems On successful completion, students will be able to ▪ understand the basics of mathematical modeling of engineering systems. ▪ model and simulate common mechatronic systems. ▪ apply mechatronic systems for a given application. ▪ understand the basics of actuators, sensors, and system integration.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Mechatronic Systems

Course Code: DLBROMSY01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Numerous processes and products experience an increasing combination of traditional and advanced mechanics with electronics. Especially with information processing, this development leads to a so-called mechatronic system, with the purpose to improve overall performance. This course illustrates the development of mechatronics and focuses on some important aspects, such as modeling techniques (which are relevant for system simulation, design and optimization), common electric drives, machines and drivetrains, actuators and sensors.

Course Outcomes

On successful completion, students will be able to

- understand the basics of mathematical modeling of engineering systems.
- model and simulate common mechatronic systems.
- apply mechatronic systems for a given application.
- understand the basics of actuators, sensors, and system integration.

Contents

1. Introduction
   - 1.1 Mechatronic Systems
   - 1.2 Examples

2. Modeling
   - 2.1 Fundamental Equations
   - 2.2 Energy Balance
   - 2.3 Connection of Process Elements
   - 2.4 Dynamics of Mechanical Systems
   - 2.5 Mechanical Elements

3. Electrical Drives
   - 3.1 Electromagnets
   - 3.2 Direct Current Motors
   - 3.3 Alternating Current Motors

4. Machines and Drivetrains
   - 4.1 Complete Machines
   - 4.2 Characteristics and Stability of Machines
   - 4.3 Motors and Pumps
   - 4.4 Automobile Drivetrain
   - 4.5 Signal Energy
   - 4.6 Applications

5. Actuators and Sensors
   - 5.1 Basic Structures
   - 5.2 Electromechanical Drives
   - 5.3 Hydraulic Actuators
   - 5.4 Pneumatic Actuators
   - 5.5 Unconventional Actuators

Literature

Compulsory Reading

Further Reading

- Boukas, E. K./Al-Sunni, F. M. (2012): Mechatronic systems: Analysis, design and implementation. Springer, Berlin.
- Davim, J. P. (2011): Mechatronics. John Wiley & Sons, Hoboken, NJ.
- Isermann, R. (2005): Mechatronic systems: Fundamentals. Springer, London.
- Janschek, K./Richmond, K. (2012): Mechatronic systems design methods, models, concepts. Springer, Berlin

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Control Systems Engineering

Module Code: DLBROCSE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBROSS01_E	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Matthias Eifler (Control Systems Engineering)

Contributing Courses to Module

- Control Systems Engineering (DLBROCSE01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 90 Minutes	

Weight of Module

see curriculum

Module Contents

- Introduction to control systems
- Modeling in the frequency domain
- Time response
- Stability
- Steady-state errors
- The root locus
- The frequency response
- Design via frequency response

Learning Outcomes	
Control Systems Engineering On successful completion, students will be able to ▪ understand the components of a control system. ▪ analyze properties of systems in time and frequency domains. ▪ define dynamic and static requirements in time and frequency domains. ▪ analyze the stability of dynamic systems. ▪ understand and calculate the frequency-response of systems. ▪ design standard feedback controllers to achieve target performance.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Control Systems Engineering

Course Code: DLBROCSE01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBROSS01_E

Course Description

Control systems are an integral part of modern society. They are omnipresent in mechatronics, robotics, production engineering, manufacturing processes, and medical technology. A control system is made of subsystems and processes assembled for the purpose of obtaining a desired output with desired performance, given a specified input. Control systems engineering is the discipline which analyzes systems, intended to enable the design of controllers which ensure the desired performance. This course introduces the concept of control systems and provides further understanding of systems in terms of their dynamical properties. In particular, the frequency-domain description of systems, given by the application of the Laplace Transform, is used to gain qualitative and quantitative insights into the behavior of linear time-invariant systems. The concept of frequency response is introduced in detail and is used to allow for the design of linear time-invariant feedback controllers to reach the desired performance.

Course Outcomes

On successful completion, students will be able to

- understand the components of a control system.
- analyze properties of systems in time and frequency domains.
- define dynamic and static requirements in time and frequency domains.
- analyze the stability of dynamic systems.
- understand and calculate the frequency-response of systems.
- design standard feedback controllers to achieve target performance.

Contents

1. Introduction to Control Systems
   - 1.1 Introduction and History
   - 1.2 Open-loop and Closed-loop Systems
   - 1.3 Design Objectives
   - 1.4 The Design Process
   - 1.5 Trends in Control Systems

2. Modeling in the Frequency Domain
   - 2.1 Laplace and Inverse Laplace Transform
   - 2.2 The Transfer Function

Literature

Compulsory Reading

Further Reading

- Doyle, J. C., Francis, B. A., & Tannenbaum, A. R. (2009). Feedback control theory. Dover Publications.
- Nise, N. (2015). Control systems engineering (7th ed.). Wiley.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Review Book
	☑ Audio	☑ Online Tests
	☑ Slides	

Project: Modeling and Simulation of Robots

Module Code: DLBROPMSR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	either DLBROMK01_E and DLBROMD01_E or DLBROMKD01_E	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Ha Ngo (Project: Modeling and Simulation of Robots)

Contributing Courses to Module
▪ Project: Modeling and Simulation of Robots (DLBROPMSR01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Written Assessment: Project Report	**Split Exam**
Weight of Module see curriculum	

Module Contents
Mathematical modeling of robots will be seen from a practical perspective. The students will learn how to build a static or dynamic model of robots in a simulation environment, to perform design, testing, and analysis activities.

Learning Outcomes	
Project: Modeling and Simulation of Robots On successful completion, students will be able to ▪ perform simulation of dynamic systems. ▪ name issues related to the numeric simulation of continuous-time systems. ▪ implement the dynamic model of a robot in a simulation environment. ▪ generate and discuss valid simulation results .	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Project: Modeling and Simulation of Robots

Course Code: DLBROPMSR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	either DLBROMK01_E and DLBROMD01_E or DLBROMKD01_E

Course Description

Mathematical modeling of robots is very important to be able to perform design and analysis. In the context of industrial internet of things, or Industry 4.0, the building of a so-called digital twin by means of simulation models is a central activity to many other processes, such as real-time optimization of tasks as well as fault-detection and diagnosis. In this course the students will learn how a mathematical model can be implemented in a simulation environment, to perform analysis, design, and optimization.

Course Outcomes

On successful completion, students will be able to

- perform simulation of dynamic systems.
- name issues related to the numeric simulation of continuous-time systems.
- implement the dynamic model of a robot in a simulation environment.
- generate and discuss valid simulation results .

Contents

- The course provides the basics in simulation of dynamic systems and implementation of simulation models in computer-aided simulation environments. A simulation model for industrial or mobile robots is built and students will learn how to perform analysis of the model, and use it for design optimization.

Literature

Compulsory Reading

Further Reading

- Corke, P. (2017). Robotics, Vision and Control: Fundamental Algorithms In MATLAB® (2nd ed.). Springer International Publishing, Basel.
- Klee, H., & Allen, R. (2017). Simulation of dynamic systems with MATLAB and Simulink (3rd ed.). CRC Press, Boca Raton, Florida.
- Russell, K., Shen, Q., & Sodhi, R. S. (2018). Kinematics and dynamics of mechanical systems : implementation in MATLAB and SimMechanics (2nd ed.). CRC Press, Boca Raton, Florida.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Project: Introduction to Robot Control

Module Code: DLBROPIRC_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBROPMSR01_E	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Ha Ngo (Project: Introduction to Robot Control)

Contributing Courses to Module
▪ Project: Introduction to Robot Control (DLBROPIRC01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Written Assessment: Project Report	**Split Exam**
Weight of Module see curriculum	

Module Contents
This course provides an introduction to the design of servo-level robot controllers. The students will learn how to set up a simulation model of a robot which considers the presence of actuators, sensors, and control systems. Standard control approaches will be tested and evaluated.

Learning Outcomes	
Project: Introduction to Robot Control On successful completion, students will be able to ▪ understand the lower levels of a robot control system. ▪ name standard control approaches for robot motion. ▪ implement the controllers and evaluate the performance in simulation .	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Project: Introduction to Robot Control

Course Code: DLBROPIRC01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBROPMSR01_E

Course Description

Robot control allows a robot to perform the required task. Complex tasks, sometimes called missions, are subdivided into simpler subtasks that constitute elementary actions to be performed by the robot. The robot control system acts at different levels. This course focuses on the lower levels, which deal with the execution of elementary actions and are based on the real-time interaction of the robot system with the environment as well as with the actuators moving the joints. The students will learn how to implement and evaluate standard control approaches, such as Proportional-Integral-Derivative controllers, on a mathematical model of a robot.

Course Outcomes

On successful completion, students will be able to

- understand the lower levels of a robot control system.
- name standard control approaches for robot motion.
- implement the controllers and evaluate the performance in simulation .

Contents

- This course provides an introduction to the design of servo-level robot controllers. The students will learn how to set up a simulation model of a robot which considers the presence of actuators, sensors, and control systems. Standard control approaches will be tested and evaluated.

Literature

Compulsory Reading

Further Reading

- Corke, P. (2017). Robotics, Vision and Control: Fundamental Algorithms In MATLAB® (2nd ed.). Springer International Publishing, Basel.
- Klee, H., & Allen, R. (2017). Simulation of dynamic systems with MATLAB and Simulink (3rd ed.). CRC Press, Boca Raton, Florida.
- Russell, K., Shen, Q., & Sodhi, R. S. (2018). Kinematics and dynamics of mechanical systems : implementation in MATLAB and SimMechanics (2nd ed.). CRC Press, Boca Raton, Florida.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Embedded Systems

Module Code: DLBROES_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Jacko Nudzor (Embedded Systems)

Contributing Courses to Module

- Embedded Systems (DLBROES01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Embedded systems architecture
- Embedded hardware
- Embedded software
- Embedded Operating Systems
- Distributed systems and IoT architecture

Learning Outcomes	
Embedded Systems On successful completion, students will be able to ▪ understand the architecture of embedded systems. ▪ understand real-time embedded systems. ▪ design the main architecture of embedded systems for robotics, automation and IoT infrastructure.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Embedded Systems

Course Code: DLBROES01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

To realize working engineering systems, embedded systems are required. Through embedding microprocessor-based systems capable of networking, data exchange and processing, the functionality of products and systems can be enhanced in terms of features, precision, accuracy, dynamic properties, intelligence. Actually, an embedded system is where everything begins. This course provides the basics on embedded system, by focusing on the architectural patterns of modern systems and platforms. The embedded hardware and software aspects are addressed. This course also introduces connectivity and networking aspects, which are required to build distributed systems for the internet of things and the industrial internet of things (finally yielding Cyber-Physical Systems).

Course Outcomes

On successful completion, students will be able to

- understand the architecture of embedded systems.
- understand real-time embedded systems.
- design the main architecture of embedded systems for robotics, automation and IoT infrastructure.

Contents

1. Introduction
    - 1.1 Embedded Systems Overview
    - 1.2 Hardware Elements of an Embedded System
    - 1.3 Standards, Compilers and Programming Languages
2. Elements of a Microcontroller
    - 2.1 Central Processing Units
    - 2.2 Volatile and non-volatile memory
    - 2.3 Digital/Analog Input/Output
    - 2.4 Timing peripherals
    - 2.5 Communication peripherals
3. Programming a Microcontroller

3.1 Bone Structure of a Microcontroller Software
3.2 Low-Level Programming
3.3 Usage of Middle-Level Libraries
3.4 Common IDEs and Tools

4. Embedded Operating Systems
   4.1 Task Management
   4.2 Scheduler
   4.3 Examples of Embedded Operating Systems

5. Distributed Systems and IoT Architecture
   5.1 Network Interfaces
   5.2 The Internet Protocol
   5.3 Examples of Distributed Systems

Literature

Compulsory Reading

Further Reading

- Noergaard, T. (2013). Embedded systems architecture: A comprehensive guide for engineers and programmers (2nd ed.). Newnes.
- White, E. (2011). Making embedded systems: Design patterns for great software. O'Reilly Media.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Project: Robotics

Module Code: DLBROPR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Ha Ngo (Project: Robotics)

Contributing Courses to Module
▪ Project: Robotics (DLBROPR01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Oral Project Report	**Split Exam**
Weight of Module see curriculum	

Module Contents
This course illustrates the basic steps for the design of a robotic system: from concept design, modeling, simulation and construction, to implementation of hardware and software, and finally operation.

Learning Outcomes	
Project: Robotics On successful completion, students will be able to ▪ design a concept for a functioning robot. ▪ select appropriate hardware and software tools. ▪ apply control concepts to existent hardware and software of embedded systems.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Project: Robotics

Course Code: DLBROPR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The main steps to obtain a functioning robot are as follows: concept design, modeling simulation and testing of the concept, performance evaluation, optimization of the concept, prototyping, hardware and software implementation, and, finally, operation and performance assessment. In this course the students will learn all steps with emphasis on the realization, hardware and software implementation, either of a complete robot concept or of individual parts of a robot concept.

Course Outcomes

On successful completion, students will be able to

- design a concept for a functioning robot.
- select appropriate hardware and software tools.
- apply control concepts to existent hardware and software of embedded systems.

Contents

- This course provides the basics for the design, evaluation, and particularly the implementation in hardware and software of a working robot or parts of a robot.

Literature

Compulsory Reading

Further Reading

- Cicolani, J. (2018): Beginning Robotics with Raspberry Pi and Arduino. Beginning Robotics with Raspberry Pi and Arduino. Apress, New York City, NY.
- Corke, P. (2017): Robotics, Vision and Control: Fundamental Algorithms In MATLAB, 2nd ed., Springer International Publishing, Chams.
- Perch, K. (2018): Hands-on robotics with JavaScript: build robotic projects using Johnny-Five and control hardware with JavaScript and Raspberry Pi. Packt Publishing, Birmingham.
- Staple, D. (2018): Learn robotics programming: build and control autonomous robots using Raspberry Pi 3 and Python. Packt Publishing, Birmingham.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

5. Semester

Seminar: Human-Robot Interaction

Module Code: DLBROSHRI_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Amir Al-Munajjed (Seminar: Human-Robot Interaction)

Contributing Courses to Module

- Seminar: Human-Robot Interaction (DLBROSHRI01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Written Assessment: Research Essay Study Format: myStudies Written Assessment: Research Essay	**Split Exam**
Weight of Module see curriculum	

Module Contents

In this course several aspects in the design field of human-robot interaction will be investigated, ranging from fundamentals (design basics, ethics) to application in robot design, such as finding metrics for the assessment of the emotional impact of a robot design, as well as ongoing and future developments (e.g., use of artificial intelligence).

Learning Outcomes	
Seminar: Human-Robot Interaction On successful completion, students will be able to ▪ understand state-of-the-art human-robot interaction approaches and accompanying problems. ▪ name important design issues for social robots. ▪ measure the emotional component of robots. ▪ apply design patterns to develop social robots.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Seminar: Human-Robot Interaction

Course Code: DLBROSHRI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Over the past few years, significant technological development has been made in the field of Robotics and Design. Whereas industrial robots have replaced a significant proportion of human workers in industrial environments, the last decades have witnessed the development of robots designed to work together with humans. With this developments Human-Robot Interaction, i.e., a robot design methodology which considers theses interactions, has become a requirement. Robots are increasingly becoming a part of human lives and will impact human lives even more in the future. Innovative design approaches such as emotional design, based on pleasure and usability, are effective methods to develop innovative robots that can properly interact and communicate with humans, also at an emotional level. This course provides an overview on technological and design issues about “social robot design”.

Course Outcomes

On successful completion, students will be able to

- understand state-of-the-art human-robot interaction approaches and accompanying problems.
- name important design issues for social robots.
- measure the emotional component of robots.
- apply design patterns to develop social robots.

Contents

- In this course several aspects in the design field of human-robot interaction will be investigated, ranging from fundamentals (design basics, ethics) to application in robot design, such as finding metrics for the assessment of the emotional impact of a robot design, as well as ongoing and future developments (e.g., use of artificial intelligence).

Literature
Compulsory Reading
Further Reading ▪ Ayanoğlu, H./Duarte, E. (Eds.) (2019): Emotional Design in Human-Robot Interaction. Springer International Publishing, Chams. ▪ Brooks, R. A. (2003): Flesh and machines: how robots will change us. Vintage Books, New York City, NY. ▪ Kanda, T./Ishiguro, H. (2013): Human-Robot Interaction in Social Robotics. CRC Press, Boca Raton, FL.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Learning Material	**Exam Preparation**
☑ Slides	☑ Guideline

Project: Applied Robotics with Robotic Platforms

Module Code: DLBROPARRP_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Florian Simroth (Project: Applied Robotics with Robotic Platforms)

Contributing Courses to Module

- Project: Applied Robotics with Robotic Platforms (DLBROPARRP01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Oral Project Report	**Split Exam**
Weight of Module see curriculum	

Module Contents

This module provides students with the basic competence to use existing robotic software and hardware platforms to design, create and implement robots.

Learning Outcomes	
Project: Applied Robotics with Robotic Platforms On successful completion, students will be able to ▪ name several existing open-source robotic platforms. ▪ understand the basic principles of robotic platforms. ▪ work with existing robotic platforms. ▪ carry out a robotic project by means of robotic platforms.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Project: Applied Robotics with Robotic Platforms

Course Code: DLBROPARRP01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In the last years several robotic software and hardware platforms have been developed. The existing diverse robotic systems provide an affordable and reliable basis to build next generation robots. Some of those systems are open source and constantly developed by the community of roboticists. Of course, such systems require a minimal understanding of robotics as well as of other robotics-related issues which are important in today's technical community, such as internet of things and communication interfaces. This course provides the basics to work with such robotic platforms for development, design and implementation of industrial and mobile robots.

Course Outcomes

On successful completion, students will be able to

- name several existing open-source robotic platforms.
- understand the basic principles of robotic platforms.
- work with existing robotic platforms.
- carry out a robotic project by means of robotic platforms.

Contents

- This course illustrates robotic platforms and their usage within robotics projects.

Literature

Compulsory Reading

Further Reading

- Cacace, J./Joseph, L. (2018): Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System. 2nd ed., Packt Publishing, Birmingham.
- Koubaa, A. (ed.) (2018): Robot operating system (ROS): the complete reference. Volume 1. Springer, Cham.
- Quigley, M./Gerkey, B./Smart, W. D. (2015): Programming robots with ROS. O'Reilly, Sebastopol, CL.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Seminar: Robots and Society

Module Code: DLBROSRS_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Maedeh Ranjbar-Zefreh (Seminar: Robots and Society)

Contributing Courses to Module

- Seminar: Robots and Society (DLBROSRS01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Research Essay	

Weight of Module

see curriculum

Module Contents

This course addresses major topics in robotics and society, for instance applications of robots in healthcare or the impact of human-replacing robots in the labor market.

Learning Outcomes	
Seminar: Robots and Society On successful completion, students will be able to ▪ name current impact areas of robotics in society. ▪ understand the main technological and ethical issues related to robotics and society. ▪ indicate future trends and developments.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Seminar: Robots and Society

Course Code: DLBROSRS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Robots are increasingly becoming part of our lives, not being confined to the industrial sphere, but able to interact, communicate and perform tasks together with humans. In this course, students will address the topic of how robots will impact our society from various perspectives, such as ethics, work, health, performance, comfort and support.

Course Outcomes

On successful completion, students will be able to

- name current impact areas of robotics in society.
- understand the main technological and ethical issues related to robotics and society.
- indicate future trends and developments.

Contents

- This course addresses major topics in robotics and society, for instance applications of robots in healthcare or the impact of human-replacing robots in the labor market. Students will investigate in detail one of these aspects and gain important insights on future development and trends to be taken into consideration when developing innovative robots and robotic systems.

Literature

Compulsory Reading

Further Reading

- Ayanoğlu, H./Duarte, E. (eds.) (2019) : Emotional Design in Human-Robot Interaction. Springer International Publishing, Cham.
- Brooks, R. A. (2003): Flesh and machines: how robots will change us. Vintage Books, New York City, NY.
- Corrales, M./Fenwick, M./Forgó, N. (eds.) (2018): Robotics, AI and the Future of Law. Springer, Singapore.
- Nyholm, S. (2020): Humans and robots: ethics, agency, and anthropomorphism. Rowman & Littlefield Publishers, Lanham, ML.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Safety of Industrial Plants and Machines

Module Code: DLBROSIPM_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	5	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Torsten Bruns (Safety of Industrial Plants and Machines)

Contributing Courses to Module
▪ Safety of Industrial Plants and Machines (DLBROSIPM01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Methods
- Identification of weak spots
- Product safety
- Declaration of conformity
- FMEA

Learning Outcomes	
Safety of Industrial Plants and Machines On successful completion, students will be able to ▪ assess the need for product safety measures. ▪ assess the degree of compliance with the Machinery Directive (Directive 2006/42/EC). ▪ perform an FMEA. ▪ determine the Performance Level (PL). ▪ apply methods and processes for system analysis and avoid weak points preemptively.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Safety of Industrial Plants and Machines

Course Code: DLBROSIPM01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, students will get an overview of the Machinery Directive (Directive 2006/42/EC), which regulates the protective measures for complete and partial machines or systems concerning the prevention of accidents. Participants will gain necessary skills to put a machine on the market. This includes risk assessment and a subsequent declaration of conformity (for complete machines) or declaration of incorporation (for partial machines) in accordance with the Machinery Directive (Directive 2006/42/EC). The Declaration of Conformity or Declaration of Incorporation, in turn, is a prerequisite for acquiring the CE label for complete machines. It refers to protective measures not only for the operator, but also for the environment. In addition, students will be able to determine the Performance Level (PL) as part of risk assessment, a measure of the reliability of a safety function of security-related parts of the control system. The recommended measures must be implemented by both the manufacturer and the operator. All these security-related aspects are evaluated in risk assessment and appropriate measures are proposed or recommendations are made to reduce or avoid hazards.

Course Outcomes

On successful completion, students will be able to

- assess the need for product safety measures.
- assess the degree of compliance with the Machinery Directive (Directive 2006/42/EC).
- perform an FMEA.
- determine the Performance Level (PL).
- apply methods and processes for system analysis and avoid weak points preemptively.

Contents

1. Introduction and Basics
   - 1.1 Safety Engineering
   - 1.2 Legal Aspects and Product Liability

2. EU Directives, Laws and Standards
   - 2.1 Important CE Directives
   - 2.2 Standards

3. Risk Assessment

Literature

Compulsory Reading

Further Reading

- Jespen, Torben. (2016). Risk Assessments and Safe Machinery Ensuring Compliance with the EU Directives. Springer International Publishing.
- David J. Smith, & Kenneth G. L. Simpson. (2016). The Safety Critical Systems Handbook : A Straightforward Guide to Functional Safety: IEC 61508 (2010 Edition), IEC 61511 (2015 Edition) and Related Guidance: Vol. Fourth edition. Butterworth-Heinemann.
- D.H. Stamatis. (2019). Risk Management Using Failure Mode And Effect Analysis (FMEA). ASQ Quality Press.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Industrial Robotics and Automation

Module Code: DLBROEIRA_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Handling Technology) / Aditya Mushyam (Automation Technology)

Contributing Courses to Module

- Handling Technology (DLBROEIRA01_E)
- Automation Technology (DLBROEIRA02_E)

Module Exam Type	
Module Exam	**Split Exam** Handling Technology • Study Format "Distance Learning": Exam, 90 Minutes Automation Technology • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes
Weight of Module see curriculum	

<table>
<tr><td colspan="2">

Module Contents

Handling Technology

- Industrial Handling
- Delivery systems
- End effector/manipulator /Gripper
- Material flow

Automation Technology

- Modern automation systems
- Programmable logic controllers
- Batch automation
- SCADA
- Industrial communications
- Distributed control systems
- Cyber-security

</td></tr>
<tr><td colspan="2">

Learning Outcomes

Handling Technology

On successful completion, students will be able to

- assign terms and elements to conventional and flexible automated handling and assembly technology.
- analyze processes in handling.
- design methods for the development of assembly and handling tasks.
- influence component design through analysis, so that production-ready design can commence in the course of the construction phase.

Automation Technology

On successful completion, students will be able to

- understand modern automation systems.
- identify trends and challenges.
- design an industrial automation system for an application.
- name relevant cyber-security issues.

</td></tr>
<tr><td>

Links to other Modules within the Study Program

This module is similar to other modules in the field of Engineering

</td><td>

Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology fields

</td></tr>
</table>

Handling Technology

Course Code: DLBROEIRA01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In handling, a defined orientation of a geometrically defined object is either created or maintained for a limited time. Typical handling devices, such as industrial robots or handling devices, are program-controlled.This course provides an overview of the standards of conventional handling technology. In addition, the knowledge of flexible handling technology is deepened, with a focus on characteristic pick and place applications and Gripper / Manipulator / Endeffector technology.

Course Outcomes

On successful completion, students will be able to

- assign terms and elements to conventional and flexible automated handling and assembly technology.
- analyze processes in handling.
- design methods for the development of assembly and handling tasks.
- influence component design through analysis, so that production-ready design can commence in the course of the construction phase.

Contents

1. Introduction
   - 1.1 Definitions
   - 1.2 Requirements
2. Handling Objects
   - 2.1 Component Regulations
   - 2.2 Component Actions (Stability/Movement Sequences)
   - 2.3 Handling-Oriented Component Design
   - 2.4 Design for manufacturing and assembly
3. Handling Procedures
   - 3.1 Functions
   - 3.2 Illustrations
   - 3.3 Functional Diagrams

4. Standard and Delivery Systems
    - 4.1 Memory
    - 4.2 Motion Systems
    - 4.3 Delivery
    - 4.4 Branching
    - 4.5 Sorting
    - 4.6 Allocation
    - 4.7 Safety Equipment
    - 4.8 Control Systems

5. Flexible Handling Technology
    - 5.1 Tasks and Types (IR, Cobot)
    - 5.2 Pick and Place
    - 5.3 Drives
    - 5.4 Gripper technology

6. Transfer Systems
    - 6.1 Workpiece Carrier
    - 6.2 Chaining

7. Security
    - 7.1 Technical Safety Requirements
    - 7.2 Malfunction During Operation

Literature

Compulsory Reading

Further Reading

- Annals of Scientific Society for Assembly, Handling and Industrial Robotics 2021. (2022). Springer Nature.
- Khatib, O., & Siciliano, B. (2016). Springer handbook of robotics (2nd edition). Springer.
- Stephens, Matthew P. (2019). Manufacturing Facilities Design & Material Handling; Sixth Edition. Purdue University Press
- Schütz, Daniel/Wahl, Friedrich M. (2011). Robotic Systems for Handling and Assembly. (2011). Springer Tracts in Advanced Robotics. Berlin Heidelberg.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Automation Technology

Course Code: DLBROEIRA02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Automation technology refers to the analysis, design and improvement of existing or new automation systems. Modern automation systems are characterized by the combination of many different devices, such as actuators, sensors, machines, which must be able to perform a coordinate action and to exchange data with each other. This course introduces such modern automation systems by listing their necessary components, presenting current challenges and trends and explaining communication technologies to build effective industrial automation networks. A brief overview on the topic of cyber-security is also given.

Course Outcomes

On successful completion, students will be able to

- understand modern automation systems.
- identify trends and challenges.
- design an industrial automation system for an application.
- name relevant cyber-security issues.

Contents

1. Introduction
   - 1.1 Evolution of Automation
   - 1.2 Industrial Revolutions
   - 1.3 Modern Automation Systems
   - 1.4 Challenges and Trends

2. An Introduction to Programmable Logic Controllers
   - 2.1 Hardware
   - 2.2 Internal Architecture
   - 2.3 I/O
   - 2.4 Ladder and Functional Block Programming
   - 2.5 Programming Methods

3. Batch Automation
   - 3.1 Basics

3.2 Applications

4. SCADA Systems
   4.1 Overview
   4.2 Components
   4.3 Communication Technologies
   4.4 Interfaces

5. Industrial Communication Technologies
   5.1 Industrial Networks
   5.2 HART
   5.3 PROFIBUS
   5.4 Wireless Communication
   5.5 OPC
   5.6 Konnex (EIB/KNX)
   5.7 LonWorks®

6. Distributed Control System
   6.1 Evolution of Control Systems
   6.2 Components of Distributed Control Systems

7. Cyber Security in Industrial Automation
   7.1 Plant Control Network
   7.2 Cyber Attacks
   7.3 Common Industrial Software Weaknesses

Literature

Compulsory Reading

Further Reading

- Dey, C., & Sen, S. (2020). Industrial automation technologies. CRC.
- Gardner, R. F. (2020). Introduction to plant automation and controls. CRC.
- Lehto, M., & Neittaanmäki, P. (2015). Cyber security: Analytics, technology and automation. Springer.
- Mehta, B. R., & Reddy, Y. J. (2014). Industrial process automation systems: Design and implementation. Elsevier.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam

Service Robotics

Module Code: DLBROESR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Dr. Florian Simroth (Mobile Robotics) / Dr. Florian Simroth (Soft Robotics)

Contributing Courses to Module
▪ Mobile Robotics (DLBROESR01_E) ▪ Soft Robotics (DLBROESR02_E)

Module Exam Type	
Module Exam	**Split Exam** Mobile Robotics • Study Format "Distance Learning": Written Assessment: Case Study Soft Robotics • Study Format "Distance Learning": Written Assessment: Written Assignment
Weight of Module see curriculum	

Module Contents

Mobile Robotics

- Locomotion
- Kinematics and dynamics
- Perception
- Mobile manipulators
- Path motion and task planning
- Localization and mapping

Soft Robotics

- Soft robotics
- Actuators for soft robots
- Sensors for soft robots
- Applications of soft robots

Learning Outcomes

Mobile Robotics

On successful completion, students will be able to

- understand mobile robot locomotion, kinematics, and dynamics.
- model and simulate a wheeled, legged, or aerial mobile robot.
- understand common approaches for localization and mapping.
- apply and simulate path, motion, and task planning algorithms.
- simulate and understand mobile manipulators.

Soft Robotics

On successful completion, students will be able to

- know the basics behind soft robots.
- understand and analyze common structures of soft robots.
- choose the best soft robot technology for a given application.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Mobile Robotics

Course Code: DLBROESR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Modern robots are mobile robots, able to move in spaces and perform tasks autonomously. This is for instance what is done by household robots, or by robots working in warehouses. In the last years, such robots have been improved by the implementation of advanced localization and task planning algorithms, which are based on the fundamentals of mobile robot kinematics and dynamics. This course starts with an introduction to the main concepts of robot locomotion, presenting the three main categories of mobile robots, namely legged, wheeled and aerial (often called drones). As second focus lies on the necessary mathematical foundation. This course, thus, discusses kinematics and dynamics of mobile robots. The topic of how a mobile robot can perceive the surrounding world is treated in detail in a third part of this course, where sensors for mobile robots are introduced together with an introduction on advanced topics such as robot vision and image processing. The last part of this course describes the main approaches for localization, mapping and motion and task planning. A brief overview on combination of mobile robots and manipulators, i.e., mobile manipulators, is also given.

Course Outcomes

On successful completion, students will be able to

- understand mobile robot locomotion, kinematics, and dynamics.
- model and simulate a wheeled, legged, or aerial mobile robot.
- understand common approaches for localization and mapping.
- apply and simulate path, motion, and task planning algorithms.
- simulate and understand mobile manipulators.

Contents

1. Locomotion
   - 1.1 Basics
   - 1.2 Legged Mobile Robots
   - 1.3 Wheeled Mobile Robots
   - 1.4 Aerial Mobile Robots

2. Kinematics
   - 2.1 Basics
   - 2.2 Kinematic Models and Constraints

Literature
Compulsory Reading
Further Reading ▪ Corke, P. (2017): Robotics, Vision and Control: Fundamental Algorithms In MATLAB. 2nd ed., Springer International Publishing, Cham. ▪ Siciliano, B./Khatib, O. (eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Cham. ▪ Siegwart, R./Nourbakhsh, I. R./Scaramuzza, D. (2011): Introduction to Autonomous Mobile Robots. The MIT Press, Cambridge, MS. ▪ Tzafestas, S. G. (2013): Introduction to Mobile Robot Control. Elsevier Inc, Amsterdam.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Soft Robotics

Course Code: DLBROESR02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Classic robots are made of rigid links and structures. In the last years, the field of robotics has been strongly influenced and inspired by biological processes. Instead of rigid structures, soft structures, materials, and surfaces are characterizing innovative, soft robots. This new generation of robots can be used in several applications where highly dynamic tasks must be performed in unsafe or rough environments, and especially where the interaction with humans is necessary. This course provides the basics in the fast-changing field of soft robotics, starting with an overview of materials and technologies for soft actuators, proceeding with an overview on innovative sensors, and concluding with an overview on modeling approaches for soft robots. The last part summarizes some relevant state-of-the-art applications.

Course Outcomes

On successful completion, students will be able to

- know the basics behind soft robots.
- understand and analyze common structures of soft robots.
- choose the best soft robot technology for a given application.

Contents

1. Introduction
   - 1.1 Soft Robots
   - 1.2 Challenges
   - 1.3 Trends
   - 1.4 Applications

2. Actuators
   - 2.1 Soft Actuators and Their Classification
   - 2.2 Materials and Properties of Soft Actuators
   - 2.3 Thermo-Driven Soft Actuators
   - 2.4 Electro-Driven Soft Actuators
   - 2.5 Light-Driven Soft Actuators
   - 2.6 Magneto-Driven Soft Actuators
   - 2.7 Pneumatic Soft Actuators

Literature

Compulsory Reading

Further Reading

- Asaka, K./Okuzaki, H. (eds.) (2019): Soft actuators: materials, modeling, applications, and future perspectives. Springer, Singapore.
- Kim, J. (2017): Microscale Soft Robotics. Springer International Publishing, Cham.
- Siciliano, B./Khatib, O. (eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Cham.
- Verl, A., et al (eds.) (2015): Soft Robotics: Transferring Theory to Application. Soft Robotics. Springer, Berlin.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Cognitive Robotics

Module Code: DLBROECR

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Matthias Eifler (Digital Signal Processing) / Prof. Dr. Armin Grasnick (Introduction to Computer Vision)

Contributing Courses to Module

- Digital Signal Processing (DLBROEICR01_E)
- Introduction to Computer Vision (DLBAIICV01)

Module Exam Type

Module Exam	Split Exam
	<u>Digital Signal Processing</u> • Study Format "Distance Learning": Exam, 90 Minutes (50) <u>Introduction to Computer Vision</u> • Study Format "Distance Learning": Exam, 90 Minutes (100) • Study Format "myStudies": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents	
Digital Signal Processing ▪ Signal Sampling and Quantization ▪ Digital Signals and Systems ▪ Discrete Fourier Transform ▪ Z-Transform ▪ Digital Signal Processing and Filters **Introduction to Computer Vision** ▪ Vision Fundamentals ▪ Image Filtering ▪ Low-Level Vision ▪ High-Level Vision ▪ Video	
Learning Outcomes **Digital Signal Processing** On successful completion, students will be able to ▪ analyze discrete time systems. ▪ apply analysis tools such as the Discrete Fourier Transform. ▪ apply the z-Transform. ▪ analyze properties of discrete systems. ▪ design finite and infinite impulse response filters. ▪ implement filters in hardware and software. **Introduction to Computer Vision** On successful completion, students will be able to ▪ remember important facts about image acquisition both in humans as well as technical systems. ▪ describe the importance of filtering in image processing and its practical application. ▪ know about the role and function of lower-level features such as edges or salient points in vision processing. ▪ explain how Deep Learning methods are successfully applied in high-level vision tasks. ▪ understand the particularities of video processing and know how to solve common problems related to the interpretation of video material.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Engineering and Data Science & Artificial Intelligence	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Digital Signal Processing

Course Code: DLBROEICR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Digital signal processing enables digital audio and video extraction, as well as extraction of important features from any other kind of signal, for instance medial imagery or diagnostic tools. This course provides the students with expertise on the theory and practice of digital signal processing. In the first part, theoretical concepts are introduced, presenting the main tools for analysis of digital, i.e., sampled or discrete-time systems. The core of digital signal processing resides in the design of a digital filter. The second part of the course focuses on different filter-design approaches, i.e. a discussion on finite impulse response and infinite impulse response filters. The last part gives important insights into the hardware and software implementation of digital signal processing, bridging theory with applied practice.

Course Outcomes

On successful completion, students will be able to

- analyze discrete time systems.
- apply analysis tools such as the Discrete Fourier Transform.
- apply the z-Transform.
- analyze properties of discrete systems.
- design finite and infinite impulse response filters.
- implement filters in hardware and software.

Contents

1. Introduction
   - 1.1 Basic Concepts
   - 1.2 Applications
2. Signal Sampling and Quantization
   - 2.1 Sampling
   - 2.2 Signal reconstruction
   - 2.3 Analog-to-digital Conversion
   - 2.4 Digital-to-Analog Conversion
   - 2.5 Quantization
3. Digital Signals and Systems

Literature

Compulsory Reading

Further Reading

- Manolakis, D. G./Ingle, V. K. (2011): Applied digital signal processing: theory and practice. Cambridge University Press, Cambridge.
- Tan, L./Jiang, J. (2013): Digital signal processing: fundamentals and applications. 2nd ed., Academic Press, Cambridge, MS.
- Vetterli, M./Kovačević, J./Goyal, V. K. (2014): Foundations of signal processing. 2nd ed., Cambridge University Press, Cambridge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Introduction to Computer Vision

Course Code: DLBAIICV01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	None

Course Description

This course aims at laying the foundation in the understanding of Computer Vision. To this end, it starts with an introduction of the image acquisition process both from a biological as well as a technical perspective. Building upon that, the importance of filtering in image processing is explained and the necessary conceptual background is laid out. This enables the subsequent presentation of how crucial low-level features are generated from the raw image material. From there, the exposition moves on to describing current approaches to relevant high-level vision problems such as object recognition or image classification. Finally, the processing of video information is treated together with an exposition on modern approaches to solving salient Computer Vision tasks in this setting.

Course Outcomes

On successful completion, students will be able to

- remember important facts about image acquisition both in humans as well as technical systems.
- describe the importance of filtering in image processing and its practical application.
- know about the role and function of lower-level features such as edges or salient points in vision processing.
- explain how Deep Learning methods are successfully applied in high-level vision tasks.
- understand the particularities of video processing and know how to solve common problems related to the interpretation of video material.

Contents

1. Vision Fundamentals
   - 1.1 The Human Visual System
   - 1.2 Pinhole and Lens Cameras
   - 1.3 Image Sensors

2. Image Filtering
   - 2.1 Linear Shift Invariant Systems, Convolutions and the Point Spread Function
   - 2.2 Fourier Transform and Spatial Frequency
   - 2.3 Common Image Filters (Gaussian Smoothing, Median, Mode Filters, Rank Order)

3. Low-Level Vision
   - 3.1 Blobs
   - 3.2 Edges and Lines
   - 3.3 Corners and Points of Interest

4. High Level Vision
   - 4.1 Deep Learning
   - 4.2 Image Classification
   - 4.3 Semantic Segmentation
   - 4.4 Object Recognition

5. Video
   - 5.1 Fundamentals of Video Data, Motion and Optical Flow
   - 5.2 Object Tracking
   - 5.3 Action Classification

Literature

Compulsory Reading

Further Reading

- Davies E. R. (2018). Computer Vision (5th ed.). Academic Press.
- Forsyth, D. & Ponce, J. (2011). Computer vision: A modern approach. Pearson.
- Szeliski R. (2022). Computer Vision - Algorithms and Applications (2nd ed.). Springer.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

6. Semester

Industrial Robotics and Automation

Module Code: DLBROEIRA_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Handling Technology) / Aditya Mushyam (Automation Technology)

Contributing Courses to Module
▪ Handling Technology (DLBROEIRA01_E) ▪ Automation Technology (DLBROEIRA02_E)

Module Exam Type	
Module Exam	**Split Exam** Handling Technology • Study Format "Distance Learning": Exam, 90 Minutes Automation Technology • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents
Handling Technology ▪ Industrial Handling ▪ Delivery systems ▪ End effector/manipulator /Gripper ▪ Material flow **Automation Technology** ▪ Modern automation systems ▪ Programmable logic controllers ▪ Batch automation ▪ SCADA ▪ Industrial communications ▪ Distributed control systems ▪ Cyber-security

Learning Outcomes
Handling Technology On successful completion, students will be able to ▪ assign terms and elements to conventional and flexible automated handling and assembly technology. ▪ analyze processes in handling. ▪ design methods for the development of assembly and handling tasks. ▪ influence component design through analysis, so that production-ready design can commence in the course of the construction phase. **Automation Technology** On successful completion, students will be able to ▪ understand modern automation systems. ▪ identify trends and challenges. ▪ design an industrial automation system for an application. ▪ name relevant cyber-security issues.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Handling Technology

Course Code: DLBROEIRA01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In handling, a defined orientation of a geometrically defined object is either created or maintained for a limited time. Typical handling devices, such as industrial robots or handling devices, are program-controlled.This course provides an overview of the standards of conventional handling technology. In addition, the knowledge of flexible handling technology is deepened, with a focus on characteristic pick and place applications and Gripper / Manipulator / Endeffector technology.

Course Outcomes

On successful completion, students will be able to

- assign terms and elements to conventional and flexible automated handling and assembly technology.
- analyze processes in handling.
- design methods for the development of assembly and handling tasks.
- influence component design through analysis, so that production-ready design can commence in the course of the construction phase.

Contents

1. Introduction
   - 1.1 Definitions
   - 1.2 Requirements
2. Handling Objects
   - 2.1 Component Regulations
   - 2.2 Component Actions (Stability/Movement Sequences)
   - 2.3 Handling-Oriented Component Design
   - 2.4 Design for manufacturing and assembly
3. Handling Procedures
   - 3.1 Functions
   - 3.2 Illustrations
   - 3.3 Functional Diagrams

4. Standard and Delivery Systems
   - 4.1 Memory
   - 4.2 Motion Systems
   - 4.3 Delivery
   - 4.4 Branching
   - 4.5 Sorting
   - 4.6 Allocation
   - 4.7 Safety Equipment
   - 4.8 Control Systems

5. Flexible Handling Technology
   - 5.1 Tasks and Types (IR, Cobot)
   - 5.2 Pick and Place
   - 5.3 Drives
   - 5.4 Gripper technology

6. Transfer Systems
   - 6.1 Workpiece Carrier
   - 6.2 Chaining

7. Security
   - 7.1 Technical Safety Requirements
   - 7.2 Malfunction During Operation

Literature

Compulsory Reading

Further Reading

- Annals of Scientific Society for Assembly, Handling and Industrial Robotics 2021. (2022). Springer Nature.
- Khatib, O., & Siciliano, B. (2016). Springer handbook of robotics (2nd edition). Springer.
- Stephens, Matthew P. (2019). Manufacturing Facilities Design & Material Handling; Sixth Edition. Purdue University Press
- Schütz, Daniel/Wahl, Friedrich M. (2011). Robotic Systems for Handling and Assembly. (2011). Springer Tracts in Advanced Robotics. Berlin Heidelberg.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Automation Technology

Course Code: DLBROEIRA02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Automation technology refers to the analysis, design and improvement of existing or new automation systems. Modern automation systems are characterized by the combination of many different devices, such as actuators, sensors, machines, which must be able to perform a coordinate action and to exchange data with each other. This course introduces such modern automation systems by listing their necessary components, presenting current challenges and trends and explaining communication technologies to build effective industrial automation networks. A brief overview on the topic of cyber-security is also given.

Course Outcomes

On successful completion, students will be able to

- understand modern automation systems.
- identify trends and challenges.
- design an industrial automation system for an application.
- name relevant cyber-security issues.

Contents

1. Introduction
   - 1.1 Evolution of Automation
   - 1.2 Industrial Revolutions
   - 1.3 Modern Automation Systems
   - 1.4 Challenges and Trends

2. An Introduction to Programmable Logic Controllers
   - 2.1 Hardware
   - 2.2 Internal Architecture
   - 2.3 I/O
   - 2.4 Ladder and Functional Block Programming
   - 2.5 Programming Methods

3. Batch Automation
   - 3.1 Basics

3.2 Applications

4. SCADA Systems
   - 4.1 Overview
   - 4.2 Components
   - 4.3 Communication Technologies
   - 4.4 Interfaces

5. Industrial Communication Technologies
   - 5.1 Industrial Networks
   - 5.2 HART
   - 5.3 PROFIBUS
   - 5.4 Wireless Communication
   - 5.5 OPC
   - 5.6 Konnex (EIB/KNX)
   - 5.7 LonWorks®

6. Distributed Control System
   - 6.1 Evolution of Control Systems
   - 6.2 Components of Distributed Control Systems

7. Cyber Security in Industrial Automation
   - 7.1 Plant Control Network
   - 7.2 Cyber Attacks
   - 7.3 Common Industrial Software Weaknesses

Literature

Compulsory Reading

Further Reading

- Dey, C., & Sen, S. (2020). Industrial automation technologies. CRC.
- Gardner, R. F. (2020). Introduction to plant automation and controls. CRC.
- Lehto, M., & Neittaanmäki, P. (2015). Cyber security: Analytics, technology and automation. Springer.
- Mehta, B. R., & Reddy, Y. J. (2014). Industrial process automation systems: Design and implementation. Elsevier.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam

Service Robotics

Module Code: DLBROESR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Florian Simroth (Mobile Robotics) / Dr. Florian Simroth (Soft Robotics)

Contributing Courses to Module

- Mobile Robotics (DLBROESR01_E)
- Soft Robotics (DLBROESR02_E)

Module Exam Type

Module Exam	Split Exam
	Mobile Robotics • Study Format "Distance Learning": Written Assessment: Case Study Soft Robotics • Study Format "Distance Learning": Written Assessment: Written Assignment

Weight of Module

see curriculum

Module Contents
Mobile Robotics ▪ Locomotion ▪ Kinematics and dynamics ▪ Perception ▪ Mobile manipulators ▪ Path motion and task planning ▪ Localization and mapping **Soft Robotics** ▪ Soft robotics ▪ Actuators for soft robots ▪ Sensors for soft robots ▪ Applications of soft robots

Learning Outcomes
Mobile Robotics On successful completion, students will be able to ▪ understand mobile robot locomotion, kinematics, and dynamics. ▪ model and simulate a wheeled, legged, or aerial mobile robot. ▪ understand common approaches for localization and mapping. ▪ apply and simulate path, motion, and task planning algorithms. ▪ simulate and understand mobile manipulators. **Soft Robotics** On successful completion, students will be able to ▪ know the basics behind soft robots. ▪ understand and analyze common structures of soft robots. ▪ choose the best soft robot technology for a given application.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Mobile Robotics

Course Code: DLBROESR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Modern robots are mobile robots, able to move in spaces and perform tasks autonomously. This is for instance what is done by household robots, or by robots working in warehouses. In the last years, such robots have been improved by the implementation of advanced localization and task planning algorithms, which are based on the fundamentals of mobile robot kinematics and dynamics. This course starts with an introduction to the main concepts of robot locomotion, presenting the three main categories of mobile robots, namely legged, wheeled and aerial (often called drones). As second focus lies on the necessary mathematical foundation. This course, thus, discusses kinematics and dynamics of mobile robots. The topic of how a mobile robot can perceive the surrounding world is treated in detail in a third part of this course, where sensors for mobile robots are introduced together with an introduction on advanced topics such as robot vision and image processing. The last part of this course describes the main approaches for localization, mapping and motion and task planning. A brief overview on combination of mobile robots and manipulators, i.e., mobile manipulators, is also given.

Course Outcomes

On successful completion, students will be able to

- understand mobile robot locomotion, kinematics, and dynamics.
- model and simulate a wheeled, legged, or aerial mobile robot.
- understand common approaches for localization and mapping.
- apply and simulate path, motion, and task planning algorithms.
- simulate and understand mobile manipulators.

Contents

1. Locomotion
   - 1.1 Basics
   - 1.2 Legged Mobile Robots
   - 1.3 Wheeled Mobile Robots
   - 1.4 Aerial Mobile Robots

2. Kinematics
   - 2.1 Basics
   - 2.2 Kinematic Models and Constraints

Literature
Compulsory Reading
Further Reading ▪ Corke, P. (2017): Robotics, Vision and Control: Fundamental Algorithms In MATLAB. 2nd ed., Springer International Publishing, Cham. ▪ Siciliano, B./Khatib, O. (eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Cham. ▪ Siegwart, R./Nourbakhsh, I. R./Scaramuzza, D. (2011): Introduction to Autonomous Mobile Robots. The MIT Press, Cambridge, MS. ▪ Tzafestas, S. G. (2013): Introduction to Mobile Robot Control. Elsevier Inc, Amsterdam.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Soft Robotics

Course Code: DLBROESR02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Classic robots are made of rigid links and structures. In the last years, the field of robotics has been strongly influenced and inspired by biological processes. Instead of rigid structures, soft structures, materials, and surfaces are characterizing innovative, soft robots. This new generation of robots can be used in several applications where highly dynamic tasks must be performed in unsafe or rough environments, and especially where the interaction with humans is necessary. This course provides the basics in the fast-changing field of soft robotics, starting with an overview of materials and technologies for soft actuators, proceeding with an overview on innovative sensors, and concluding with an overview on modeling approaches for soft robots. The last part summarizes some relevant state-of-the-art applications.

Course Outcomes

On successful completion, students will be able to

- know the basics behind soft robots.
- understand and analyze common structures of soft robots.
- choose the best soft robot technology for a given application.

Contents

1. Introduction
   - 1.1 Soft Robots
   - 1.2 Challenges
   - 1.3 Trends
   - 1.4 Applications

2. Actuators
   - 2.1 Soft Actuators and Their Classification
   - 2.2 Materials and Properties of Soft Actuators
   - 2.3 Thermo-Driven Soft Actuators
   - 2.4 Electro-Driven Soft Actuators
   - 2.5 Light-Driven Soft Actuators
   - 2.6 Magneto-Driven Soft Actuators
   - 2.7 Pneumatic Soft Actuators

3. Sensors
   - 3.1 Basics
   - 3.2 Types of Sensors (With Examples)
   - 3.3 Sensing Technologies

4. Modeling and Control
   - 4.1 Basics
   - 4.2 Modeling of Soft Robots (With Examples)
   - 4.3 Control of Soft Robots (With Examples)

5. Concluding Remarks
   - 5.1 Applications
   - 5.2 Challenges and Opportunities
   - 5.3 Useful Research and Projects on Soft Robotics

Literature

Compulsory Reading

Further Reading

- Asaka, K./Okuzaki, H. (eds.) (2019): Soft actuators: materials, modeling, applications, and future perspectives. Springer, Singapore.
- Kim, J. (2017): Microscale Soft Robotics. Springer International Publishing, Cham.
- Siciliano, B./Khatib, O. (eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Cham.
- Verl, A., et al (eds.) (2015): Soft Robotics: Transferring Theory to Application. Soft Robotics. Springer, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Cognitive Robotics

Module Code: DLBROECR

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Matthias Eifler (Digital Signal Processing) / Prof. Dr. Armin Grasnick (Introduction to Computer Vision)

Contributing Courses to Module

- Digital Signal Processing (DLBROEICR01_E)
- Introduction to Computer Vision (DLBAIICV01)

Module Exam Type

Module Exam	Split Exam
	Digital Signal Processing • Study Format "Distance Learning": Exam, 90 Minutes (50) Introduction to Computer Vision • Study Format "Distance Learning": Exam, 90 Minutes (100) • Study Format "myStudies": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents
Digital Signal Processing ▪ Signal Sampling and Quantization ▪ Digital Signals and Systems ▪ Discrete Fourier Transform ▪ Z-Transform ▪ Digital Signal Processing and Filters **Introduction to Computer Vision** ▪ Vision Fundamentals ▪ Image Filtering ▪ Low-Level Vision ▪ High-Level Vision ▪ Video

Learning Outcomes
Digital Signal Processing On successful completion, students will be able to ▪ analyze discrete time systems. ▪ apply analysis tools such as the Discrete Fourier Transform. ▪ apply the z-Transform. ▪ analyze properties of discrete systems. ▪ design finite and infinite impulse response filters. ▪ implement filters in hardware and software. **Introduction to Computer Vision** On successful completion, students will be able to ▪ remember important facts about image acquisition both in humans as well as technical systems. ▪ describe the importance of filtering in image processing and its practical application. ▪ know about the role and function of lower-level features such as edges or salient points in vision processing. ▪ explain how Deep Learning methods are successfully applied in high-level vision tasks. ▪ understand the particularities of video processing and know how to solve common problems related to the interpretation of video material.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Engineering and Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Digital Signal Processing

Course Code: DLBROEICR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Digital signal processing enables digital audio and video extraction, as well as extraction of important features from any other kind of signal, for instance medial imagery or diagnostic tools. This course provides the students with expertise on the theory and practice of digital signal processing. In the first part, theoretical concepts are introduced, presenting the main tools for analysis of digital, i.e., sampled or discrete-time systems. The core of digital signal processing resides in the design of a digital filter. The second part of the course focuses on different filter-design approaches, i.e. a discussion on finite impulse response and infinite impulse response filters. The last part gives important insights into the hardware and software implementation of digital signal processing, bridging theory with applied practice.

Course Outcomes

On successful completion, students will be able to

- analyze discrete time systems.
- apply analysis tools such as the Discrete Fourier Transform.
- apply the z-Transform.
- analyze properties of discrete systems.
- design finite and infinite impulse response filters.
- implement filters in hardware and software.

Contents

1. Introduction
   - 1.1 Basic Concepts
   - 1.2 Applications

2. Signal Sampling and Quantization
   - 2.1 Sampling
   - 2.2 Signal reconstruction
   - 2.3 Analog-to-digital Conversion
   - 2.4 Digital-to-Analog Conversion
   - 2.5 Quantization

3. Digital Signals and Systems

8.6 Applications

9. Hardware and Software for Digital Signal Processing
   9.1 Digital Signal Processor Architecture
   9.2 Digital Signal Processor Hardware Units
   9.3 Fixed-Point and Floating-Point Formats
   9.4 Implementation of FIR and IIR Filters in Fixed-Point
   9.5 DSP Programming Examples

Literature

Compulsory Reading

Further Reading

- Manolakis, D. G./Ingle, V. K. (2011): Applied digital signal processing: theory and practice. Cambridge University Press, Cambridge.
- Tan, L./Jiang, J. (2013): Digital signal processing: fundamentals and applications. 2nd ed., Academic Press, Cambridge, MS.
- Vetterli, M./Kovačević, J./Goyal, V. K. (2014): Foundations of signal processing. 2nd ed., Cambridge University Press, Cambridge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Introduction to Computer Vision

Course Code: DLBAIICV01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	None

Course Description
This course aims at laying the foundation in the understanding of Computer Vision. To this end, it starts with an introduction of the image acquisition process both from a biological as well as a technical perspective. Building upon that, the importance of filtering in image processing is explained and the necessary conceptual background is laid out. This enables the subsequent presentation of how crucial low-level features are generated from the raw image material. From there, the exposition moves on to describing current approaches to relevant high-level vision problems such as object recognition or image classification. Finally, the processing of video information is treated together with an exposition on modern approaches to solving salient Computer Vision tasks in this setting.

Course Outcomes

On successful completion, students will be able to

- remember important facts about image acquisition both in humans as well as technical systems.
- describe the importance of filtering in image processing and its practical application.
- know about the role and function of lower-level features such as edges or salient points in vision processing.
- explain how Deep Learning methods are successfully applied in high-level vision tasks.
- understand the particularities of video processing and know how to solve common problems related to the interpretation of video material.

Contents

1. Vision Fundamentals
   - 1.1 The Human Visual System
   - 1.2 Pinhole and Lens Cameras
   - 1.3 Image Sensors

2. Image Filtering
   - 2.1 Linear Shift Invariant Systems, Convolutions and the Point Spread Function
   - 2.2 Fourier Transform and Spatial Frequency
   - 2.3 Common Image Filters (Gaussian Smoothing, Median, Mode Filters, Rank Order)

3.	Low-Level Vision
	3.1 Blobs
	3.2 Edges and Lines
	3.3 Corners and Points of Interest
4.	High Level Vision
	4.1 Deep Learning
	4.2 Image Classification
	4.3 Semantic Segmentation
	4.4 Object Recognition
5.	Video
	5.1 Fundamentals of Video Data, Motion and Optical Flow
	5.2 Object Tracking
	5.3 Action Classification

Literature
Compulsory Reading
Further Reading ▪ Davies E. R. (2018). Computer Vision (5th ed.). Academic Press. ▪ Forsyth, D. & Ponce, J. (2011). Computer vision: A modern approach. Pearson. ▪ Szeliski R. (2022). Computer Vision - Algorithms and Applications (2nd ed.). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

AI Specialist

Module Code: DLBDSEAIS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Kristina Schaaff (Artificial Intelligence) / N.N. (Project: Artificial Intelligence)

Contributing Courses to Module

- Artificial Intelligence (DLBDSEAIS01)
- Project: Artificial Intelligence (DLBDSEAIS02)

Module Exam Type

Module Exam	Split Exam
	Artificial Intelligence • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "Duales myStudium": Exam, 90 Minutes Project: Artificial Intelligence • Study Format "Distance Learning": Portfolio • Study Format "Duales myStudium": Portfolio

Weight of Module

see curriculum

<table>
<tr><td colspan="2">
Module Contents

Artificial Intelligence

History of AI
Modern AI systems
Reinforcement learning
Natural language processing
Computer vision

Project: Artificial Intelligence
This course focuses on developing a simple AI system for a specific application and domain. A current list of topics is located in the Learning Management System.
</td></tr>
<tr><td colspan="2">
Learning Outcomes
Artificial Intelligence
On successful completion, students will be able to

chart the historical developments in artificial intelligence.
understand the approach of contemporary AI systems.
comprehend the concepts behind reinforcement learning.
analyze natural language using basic NLP techniques.
scrutinize images and their contents.

Project: Artificial Intelligence
On successful completion, students will be able to

determine the requirements for building an artificial intelligence system.
evaluate an application for an AI system.
transfer theoretically-sound and practically-proven methods and tools to an application domain.
create an AI system for a chosen application.

</td></tr>
<tr><td>Links to other Modules within the Study Program
This module is similar to other modules in the fields of Data Science & Artificial Intelligence</td><td>Links to other Study Programs of the University
All Bachelor Programs in the IT & Technology fields</td></tr>
</table>

Artificial Intelligence

Course Code: DLBDSEAIS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The quest for artificial intelligence (AI) has captured humanity's interest for many decades and has been an active research area since the 1960s. This course will give a detailed overview of the historical developments, successes, and set-backs in AI, as well as modern approaches in the development of artificial intelligence.This course gives an introduction to reinforcement learning, a process similar to how humans and animals experience the world: exploring the environment and inferring the best course of action.This course also covers the principles of natural language processing and computer vision, both of which are key ingredients for an artificial intelligence to be able to interact with its environment.

Course Outcomes

On successful completion, students will be able to

- chart the historical developments in artificial intelligence.
- understand the approach of contemporary AI systems.
- comprehend the concepts behind reinforcement learning.
- analyze natural language using basic NLP techniques.
- scrutinize images and their contents.

Contents

1. History of AI
   - 1.1 Historical Developments
   - 1.2 AI Winter
   - 1.3 Expert Systems
   - 1.4 Notable Advances
2. Modern AI Systems
   - 2.1 Narrow versus General AI
   - 2.2 Application Areas
3. Reinforcement Learning
   - 3.1 What is Reinforcement Learning?
   - 3.2 Markov Chains and Value Function

3.3 Time-Difference and Q Learning

4. Natural Language Processing (NLP)
   4.1 Introduction to NLP and Application Areas
   4.2 Basic NLP Techniques
   4.3 Vectorizing Data

5. Computer Vision
   5.1 Introduction to Computer Vision
   5.2 Image Representation and Geometry
   5.3 Feature Detection
   5.4 Semantic Segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F., Barry, W., & Paradiso, M. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Chollet, F. (2018). Deep learning with Python. Manning.
- Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O'Reilly.
- Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems (2nd ed.). O'Reilly.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.
- Grus, J. (2019). Data science from scratch: First principles with Python. O'Reilly.
- Jurafsky, D., & Martin, J. H. (2022). Speech and language processing (3rd ed.). Prentice Hall.
- Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A modern approach (4th ed., global ed.). Pearson.
- Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). MIT Press. (Adaptive Computation and Machine Learning series).
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer. (Texts in Computer Science series).

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Project: Artificial Intelligence

Course Code: DLBDSEAIS02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description
This project course will give students hands-on experience in the challenging task of designing and developing an AI system for a specific application and domain. Students will need to consider requirements and practical constraints as well as the desired output of the AI system.Following this course the students will get holistic overview of developing a specific AI-based application.

Course Outcomes

On successful completion, students will be able to

- determine the requirements for building an artificial intelligence system.
- evaluate an application for an AI system.
- transfer theoretically-sound and practically-proven methods and tools to an application domain.
- create an AI system for a chosen application.

Contents

- This project course focuses on understanding and implementing a simple AI system. Based on the course Artificial Intelligence (DLBDSEAI01), students will design and implement a simple AI system. In the first step, students will choose a specific application and domain and then use the methods from the course to analyze the requirements and outcomes before implementing their own AI application. All relevant artifacts and considerations are documented by the students in a course portfolio.

Literature
Compulsory Reading
Further Reading ▪ Bear, F./Barry, W./Paradiso, M. (2020): Neuroscience: Exploring the brain. 4th ed., Lippincott Williams and Wilkins, Baltimore, MD ▪ Geron, A. (2019): Hands-on machine learning with Scikit-Learn and TensorFlow. O'Reilly, Boston, MA. ▪ Goodfellow, I./Bengio, Y./Courville, A. (2016): Deep learning. MIT Press, Boston, MA. ▪ Grus, J. (2019): Data science from scratch: First principles with Python. O'Reilley, Sebastopol, CA. ▪ Chollet, F. (2018). Deep learning with Python. Manning. ▪ Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: concepts, tools, and techniques to build intelligent systems (Second edition). O'Reilly. ▪ Grus, J. (2019): Data science from scratch: First principles with Python. O'Reilley, Sebastopol, CA. ▪ Jurafsky, D., & Martin, J. H. (2022). Speech and language processing (3rd ed.). Prentice Hall. ▪ Russell, S. J., & Norvig, P. (2022). Artificial intelligence: a modern approach (Fourth edition, global edition). Pearson. ▪ Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed. 2022). Texts in computer science. Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Ses-sions/Learning Sprint ☑ Recorded Live Sessions	☑ Slides	☑ Guideline

Autonomous Driving

Module Code: DLBDSEAD

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Ha Ngo (Self-Driving Vehicles) / Ha Ngo (Seminar: Current Topics and Trends in Self-Driving Technology)

Contributing Courses to Module

- Self-Driving Vehicles (DLBDSEAD01)
- Seminar: Current Topics and Trends in Self-Driving Technology (DLBDSEAD02)

Module Exam Type

Module Exam	Split Exam
	<u>Self-Driving Vehicles</u> • Study Format "Duales myStudium": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes <u>Seminar: Current Topics and Trends in Self-Driving Technology</u> • Study Format "Distance Learning": Written Assessment: Research Essay • Study Format "Duales myStudium": Written Assessment: Research Essay

Weight of Module

see curriculum

<table>
<tr><td colspan="2">

Module Contents

Self-Driving Vehicles

- Safety standards
- Sensor fusion
- Computer vision
- Localization & motion
- Motion planning

Seminar: Current Topics and Trends in Self-Driving Technology

The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

</td></tr>
<tr><td colspan="2">

Learning Outcomes

Self-Driving Vehicles

On successful completion, students will be able to

- cite relevant safety standards.
- grasp the concepts of sensors and sensor fusion.
- apply computer vision techniques to detect features.
- evaluate images in terms of semantic segmentation.
- understand motion models and localization approaches.
- utilize motion planning techniques.

Seminar: Current Topics and Trends in Self-Driving Technology

On successful completion, students will be able to

- transfer theoretical knowledge and methods to new domains.
- understand recent developments in self-driving vehicles.
- create new insights based on detailed studies of current research and technology.

</td></tr>
<tr><td>

Links to other Modules within the Study Program

This module is similar to other modules in the field of Engineering

</td><td>

Links to other Study Programs of the University

All Bachelor Programmes in the IT & Technology fields

</td></tr>
</table>

Self-Driving Vehicles

Course Code: DLBDSEAD01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course focuses on the foundations of autonomous vehicles and starts with a detailed introduction to relevant safety standards in terms of functional and IT security.This course continues with a presentation of the concept of sensor fusion and discusses relevant aspects of computer vision techniques such as feature detection, calibration, and semantic segmentation.A large part of the course concerns localization and motion planning. Relevant motion models are introduced and localization techniques such as odometry, triangulation, and satellite-based systems are discussed in detail, along with path planning, motion prediction, and trajectory generation.

Course Outcomes

On successful completion, students will be able to

- cite relevant safety standards.
- grasp the concepts of sensors and sensor fusion.
- apply computer vision techniques to detect features.
- evaluate images in terms of semantic segmentation.
- understand motion models and localization approaches.
- utilize motion planning techniques.

Contents

1. Sensors
   - 1.1 Physical principles of sensors
   - 1.2 Types of sensors
   - 1.3 Sensor calibration
   - 1.4 Application scenarios

2. Sensor Fusion
   - 2.1 Elaborating data from sensors
   - 2.2 The Kalman filter
   - 2.3 Object tracking

3. Computer Vision
   - 3.1 Pixels and filters

Literature

Compulsory Reading

Further Reading

- Sciavicco, L., Villani, L., Oriolo, G., & Siciliano, B. (2009). Robotics : modelling, planning andcontrol. Springer.
- Thrun, S. (2002). Probabilistic robotics. Communications of the ACM, 45(3), 52-57.
- LaValle, S. M. (2006). Planning algorithms. Cambridge University Press.
- Watzenig, D., & Horn, M. (2016). Automated driving: Safer and more efficient future driving. Springer.

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload

Self Study	Contact Hours	Tutorial/Tutorial Support	Self Test	Independent Study	Hours Total
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

Tutorial Support	Learning Material	Exam Preparation
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Seminar: Current Topics and Trends in Self-Driving Technology

Course Code: DLBDSEAD02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This courses focuses on recent developments in the field of self-driving vehicles. Following the course Self-Driving Vehicles (DLBDSEAD01), in this course students will focus on a particular topic in the context of autonomous driving, applying the knowledge they have obtained in the first course.Finally, a research essay will be written.

Course Outcomes

On successful completion, students will be able to

- transfer theoretical knowledge and methods to new domains.
- understand recent developments in self-driving vehicles.
- create new insights based on detailed studies of current research and technology.

Contents

- The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

Literature
Compulsory Reading
Further Reading ▪ Ben-Ari, M./Mondada, F. (2018): Elements of robotics. Springer, Cham. ▪ European Union. (2001): Directive 2001/95/EG. (Available on the Internet) ▪ Fisher, R. B., et al. (2016): Dictionary of computer vision and image processing. John Wiley & Sons, Chichester. ▪ Smith, D. J./Simpson, K. (2016): The safety critical systems handbook. 4th ed., Elsevier, Oxford. ▪ Smith, D. J. (2017): Reliability, maintainability, and risk. 9th ed., Elsevier, Oxford. ▪ Society of Automobile Engineers International. (2012): SAE J3061. (Available on the Internet) ▪ Szelski, R. (2022): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden. ▪ Wang, P. K.-C. (2015): Visibility-based optimal path and motion planning (vol. 568). Springer, Cham.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Data Science and Deep Learning

Module Code: DLBROEDSDL_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Gereon Wellmann (Data Analytics and Big Data) / Dr. Lino Antoni Giefer (Deep Learning)

Contributing Courses to Module
▪ Data Analytics and Big Data (DLBINGDABD01_E) ▪ Deep Learning (DLBDBDL01_E)

Module Exam Type	
Module Exam	**Split Exam** <u>Data Analytics and Big Data</u> • Study Format "myStudies": Written Assessment: Case Study • Study Format "Distance Learning": Written Assessment: Case Study <u>Deep Learning</u> • Study Format "Distance Learning": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents

Data Analytics and Big Data

- Introduction to Data Analysis
- Statistical Basics
- Data Mining
- Big Data Methods and Technologies
- Legal Aspects of Data Analysis
- Solution Scenarios
- Application of Big Data in the Industry

Deep Learning

- Introduction
- Introduction to Neural Networks
- Training Neural Networks
- Introduction to Deep Learning Frameworks
- Classification and Optimization
- Multilayer Neural Networks
- Convolutional Neural Networks

Learning Outcomes

Data Analytics and Big Data

On successful completion, students will be able to

- distinguish between information and data and know the meaning of these terms for decision-making.
- derive the Big Data issue, especially in connection with Internet of Things, and describe it using examples.
- identify basics from statistics, which are necessary for the analysis of large data sets.
- identify the process of data mining and classify different methods in it.
- identify selected methods and technologies that are used in the Big Data context and apply them to simple examples.
- recognize the legal framework for the application of data analysis in Germany and internationally.
- identify the specific prospects and challenges of applying Big Data analyses in industry.

Deep Learning

On successful completion, students will be able to

- place concepts of deep learning in the context of machine learning and artificial intelligence.
- define different types of regression and explain the implementation of logistic regression with perceptrons.
- explain the structure and function of simple neural networks.
- explain concepts and interrelationships in training of neural networks and to partially implement these concepts.
- differentiate between deep learning frameworks.
- implement, train and optimize neural networks with the help of a Deep Learning Framework
- understand the structure and functioning of Convolutional Neural Networks and train them using a Deep Learning Framework.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Data Science & Artificial Intelligence	All Bachelor Programmes in the IT & Technology fields

Data Analytics and Big Data

Course Code: DLBINGDABD01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The aim of the course is to familiarize students with selected methods and techniques of data analysis in the context of continuously increasing, heterogeneous data sets. To this end, the fundamental relevance of Big Data methods is presented by drawing on the historical development of stored data. One decisive factor here is the continuous transmission Internet of Things sensor data to other systems. This is followed by a short introduction to the essential statistical fundamentals before the individual steps of the data mining process are discussed. In distinction to these classical procedures, selected methods are presented with which stored data in the Big Data context can be made analyzable. As data analysis is subject to certain legal frameworks, this course also covers legal aspects such as data protection. The course concludes with an overview of the practical application of Big Data methods and tools. In particular, fields of application in the industrial context are examined.

Course Outcomes

On successful completion, students will be able to

- distinguish between information and data and know the meaning of these terms for decision-making.
- derive the Big Data issue, especially in connection with Internet of Things, and describe it using examples.
- identify basics from statistics, which are necessary for the analysis of large data sets.
- identify the process of data mining and classify different methods in it.
- identify selected methods and technologies that are used in the Big Data context and apply them to simple examples.
- recognize the legal framework for the application of data analysis in Germany and internationally.
- identify the specific prospects and challenges of applying Big Data analyses in industry.

Contents

1. Introduction to Data Analysis
   - 1.1 Decisions, Information, Data
   - 1.2 Historical Development of Data Storage and Evaluation
   - 1.3 Big Data: Features and Examples
   - 1.4 Data Analysis

Literature
Compulsory Reading
Further Reading ▪ Akerkar, R., & Srinivas Sajja, P. (2016). Intelligent Techniques for Data Science. Springer. ▪ Curry, E., Auer, S., Berre, A., J., Metzger, A., Perez, M., S., & Zillner, S. (2022). Technologies and Applications for big data value. Springer. Pages 1–15 & 321–344. ▪ Hoeren, T., & Kolany-Raiser, B., (Eds.). (2018). Big data in context – Legal, social and technological insights. Springer Nature. ▪ Illowsky, B., & Dean, S. (2018). Introductory statistics. OpenStax CNX. Chapters 2 & 8. ▪ Jurafsky, D., & Martin, J. H. (2013). Speech and language processing: an introduction to natural language processing, computational linguistics, and speech recognition (2. ed.). Pearson Prentice Hall.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions		

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions		

Deep Learning

Course Code: DLBDBDL01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Owing to recent technological advances, some concepts and methods from artificial intelligence can now be applied in practice. A major concept affected by this progress are neural networks. Thanks to fast and inexpensive GPUs on the one hand and freely available and well-documented frameworks on the other hand, neural networks are used today to solve many different problems, from pattern recognition in text and images to the automated assessment of insurance claims. In this course, students are introduced to the basics of this technology and enabled to apply it using simple examples.

Course Outcomes

On successful completion, students will be able to

- place concepts of deep learning in the context of machine learning and artificial intelligence.
- define different types of regression and explain the implementation of logistic regression with perceptrons.
- explain the structure and function of simple neural networks.
- explain concepts and interrelationships in training of neural networks and to partially implement these concepts.
- differentiate between deep learning frameworks.
- implement, train and optimize neural networks with the help of a Deep Learning Framework
- understand the structure and functioning of Convolutional Neural Networks and train them using a Deep Learning Framework.

Contents

1. Introduction
   - 1.1 AI
   - 1.2 Machine Learning
   - 1.3 Deep Learning
   - 1.4 Deep Learning Frameworks

2. Introduction to Neural Networks
   - 2.1 Linear Regression
   - 2.2 Logistic Regression
   - 2.3 Perceptrons

Literature
Compulsory Reading
Further Reading ▪ Alpaydin, E. (2008): Maschinelles Lernen. Oldenbourg Wissenschaftsverlag, München. ▪ Géron, A. (2017): Praxiseinstieg Machine Learning mit Scikit-Learn und TensorFlow. Konzepte, Tools und Techniken für intelligente Systeme. O'Reilly. ▪ Rashid, T. (2017): Neuronale Netze selbst programmieren. Ein verständlicher Einstieg mit Python. O'Reilly. ▪ Russel, S. (2012): Künstliche Intelligenz – Ein moderner Ansatz. Pearson, Hallbergmoos. ▪ Zhang, Y./Wallace, B. (2016): A Sensitivity Analysis of (and Practitioners' Guide to) Convolutional Neural Networks for Sentence Classification. In: Proceedings of the Eighth International Joint Conference on Natural Language Processing, IJCNLP 2017. Asian Federation of Natural Language Processing Taipei, Taiwan.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Python for Software Engineering

Module Code: DLBROEPSE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum		BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Max Pumperla (Object Oriented and Functional Programming in Python) / Prof. Dr. Max Pumperla (Data Science Software Engineering)

Contributing Courses to Module

- Object Oriented and Functional Programming in Python (DLBDSOOFPP01)
- Data Science Software Engineering (DLBDSDSSE01)

Module Exam Type

Module Exam	Split Exam
	Object Oriented and Functional Programming in Python • Study Format "Distance Learning": Portfolio • Study Format "myStudies": Portfolio Data Science Software Engineering • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "On Campus": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents
Object Oriented and Functional Programming in Python This course introduces the students to the advanced programming concepts of object orientation and functional programming and how they are realized in the Python programming language. **Data Science Software Engineering** ▪ Traditional project management ▪ Agile project management ▪ Testing ▪ Software development paradigms ▪ From model to production

Learning Outcomes
Object Oriented and Functional Programming in Python On successful completion, students will be able to ▪ explain basic notions in object-oriented programming such as functions and classes. ▪ understand object-oriented programming concepts and their relation to software design and engineering. ▪ describe advanced function concepts in Python. ▪ recognize important ideas from functional programming. ▪ recall important libraries for functional programming in Python. **Data Science Software Engineering** On successful completion, students will be able to ▪ understand the concept of project management approaches. ▪ apply agile approaches in software development. ▪ create automated software tests. ▪ understand various software development paradigms. ▪ evaluate the necessary steps to bring models into a production environment.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology fields

Object Oriented and Functional Programming in Python

Course Code: DLBDSOOFPP01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course builds upon basic knowledge of Python programming (Introduction to Programming with Python, DLBDSIPWP) and is concerned with the exposition of advanced Python programming concepts. To this end, important notions of object-oriented programming like classes and objects and pertaining design principles are outlined. Starting from an in-depth discussion of advanced features of Python functions, functional programming concepts and their implementation in Python are conveyed.

Course Outcomes

On successful completion, students will be able to

- explain basic notions in object-oriented programming such as functions and classes.
- understand object-oriented programming concepts and their relation to software design and engineering.
- describe advanced function concepts in Python.
- recognize important ideas from functional programming.
- recall important libraries for functional programming in Python.

Contents

- This course provides students with a thorough introduction to important notions and concepts from the domain of object-oriented programming such as classes, objects, abstraction, encapsulation, inheritance, polymorphism, composition, and delegation. Additionally, the functional programming paradigm and pertaining ideas like functions as first class objects, decorators, pure functions, immutability and higher order functions are conveyed. Pursuant to the portfolio course type, the aforementioned concepts and ideas are explored by hands-on programming projects.

Literature
Compulsory Reading
Further Reading ▪ Lott, S. F. (2018): Functional Python programming: Discover the power of functional programming, generator functions, lazy evaluation, the built-in itertools library, and monads. 2nd ed., Packt Publishing, Birmingham. ▪ Lutz, M. (2013): Learning Python. 5th ed., O'Reilly. ▪ Phillips, D. (2018): Python 3 object-oriented programming: Build robust and maintainable software with object-oriented design patterns in Python 3.8. 3rd ed., Packt Publishing. ▪ Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly.

Study Format Distance Learning

Study Format Distance Learning	**Course Type** Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study 120 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 30 h	**Self Test** 0 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Data Science Software Engineering

Course Code: DLBDSDSSE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSIPWP01 or DLBDSIPWP01_D; DLBDSOOFPP01 or IOBP01

Course Description

A core part of data science is creating value from data. This means not only the creation of sophisticated predictive models but also the development of these models according to modern software development principles.This course gives a detailed overview of the relevant methods and paradigms which data scientists need to know in order to develop enterprise-grade models.This course discusses traditional and agile project management techniques, highlighting both the Kanban and Scrum approaches. It explores relevant software development paradigms such as test-driven development, pair programming, mob programming, and extreme programming.Special focus is given to the topic of testing and the consideration of how to bring a model into a production environment.

Course Outcomes

On successful completion, students will be able to

- understand the concept of project management approaches.
- apply agile approaches in software development.
- create automated software tests.
- understand various software development paradigms.
- evaluate the necessary steps to bring models into a production environment.

Contents

1. Traditional Project Management
   - 1.1 Requirements engineering
   - 1.2 Waterfall model
   - 1.3 Rational unified process

2. Agile Project Management
   - 2.1 Criticism of the waterfall model
   - 2.2 Introduction to SCRUM
   - 2.3 Introduction to Kanban

3. Testing
   - 3.1 Why testing?

3.2 Unit trests 3.3 Integration tests 3.4 Performance monitoring 4. Software Development Paradigms 4.1 Test-driven development (TDD) 4.2 Pair programming 4.3 Mob programming 4.4 Extreme programming 5. From Model to Production 5.1 Continuous delivery 5.2 Continuous integration 5.3 Building a scalable environment

Literature
Compulsory Reading
Further Reading ▪ Brookshear, G., & Brylow, D. (2019). Computer science: An overview. Pearson Education. ▪ Stephens, R. (2015). Beginning software engineering. John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format On Campus

Study Format	Course Type
On Campus	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

IT Security

Module Code: DLBROEITS-01_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Ralf Kneuper (Introduction to Data Protection and Cyber Security) / Prof. Dr. Ralf Kneuper (Cryptography)

Contributing Courses to Module
▪ Introduction to Data Protection and Cyber Security (DLBCSIDPITS01) ▪ Cryptography (DLBCSCT01-01)

Module Exam Type	
Module Exam	**Split Exam** <u>Introduction to Data Protection and Cyber Security</u> • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes <u>Cryptography</u> • Study Format "Distance Learning": Written Assessment: Case Study • Study Format "myStudies": Written Assessment: Case Study
Weight of Module see curriculum	

Module Contents

Introduction to Data Protection and Cyber Security

- Fundamentals of IT Security
- Data Protection
- IT Security Management
- Network and Communication Security

Cryptography

- Protection Targets, Vulnerabilities, and Threats
- Foundations of Cryptology and Its Core Components
- Basic Cryptographic Applications
- Authentication
- Single Computer Security
- Security Communication Network
- Security E-commerce
- Secure Software Development

Learning Outcomes

Introduction to Data Protection and Cyber Security

On successful completion, students will be able to

- explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area.
- cite the legal regulations on data protection and explain their implementation.
- discuss in-depth IT security management and suitable measures for implementation.
- use their overview knowledge of activities and strategies for IT security in software and system development.

Cryptography

On successful completion, students will be able to

- give an overview of different classes of cryptographic systems.
- give a basic description of symmetric cryptographic methods, in particular One-Time Pad, DES, and AES, and describe their operating principles by means of simple, concrete examples.
- describe the basic hash functions.
- describe basic asymmetric cryptographic methods, especially RSA, and their operating principles by means of simple, concrete examples.
- describe the areas of application of cryptographic procedures and their application scenarios.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Computer Science & Software Development	All Bachelor Programs in the IT & Technology fields

Introduction to Data Protection and Cyber Security

Course Code: DLBCSIDPITS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, the students are familiarized with important concepts from the field of IT security. Basic terms are introduced and discussed, and typical application fields, areas of IT security application, and typical procedures and techniques are introduced and described.

Course Outcomes

On successful completion, students will be able to

- explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area.
- cite the legal regulations on data protection and explain their implementation.
- discuss in-depth IT security management and suitable measures for implementation.
- use their overview knowledge of activities and strategies for IT security in software and system development.

Contents

1. Fundamentals of Data Protection and Cyber Security
    - 1.1 Conceptual Bases, Protection Goals
    - 1.2 Attacks and Threats
    - 1.3 Security Strategy
    - 1.4 Legal Regulations

2. Data Protection
    - 2.1 Data Protection as a Personal Right
    - 2.2 Basic Principles of Data Protection
    - 2.3 EU General Data Protection Regulation
    - 2.4 Further International Regulations on Data Protection
    - 2.5 Cross-Border Data Flow
    - 2.6 Data Protection in Everyday Life

3. Basic Functions of Cyber Security and Their Implementation
    - 3.1 Identification and Authentication
    - 3.2 Rights Management

Literature

Compulsory Reading

Further Reading

- Arnold, R. (2017). Cybersecurity: A business solution. An executive perspective on managing cyber risk. Threat Sketch.
- European Parliament and Council of the European Union. (2016). EU General Data Protection Regulation (GDPR): Regulation 2016/679 of the European Parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union. Chapters 1—3 .
- Mattord, H., & Whitman, M. (2017). Management of information security. Cengage.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Cryptography

Course Code: DLBCSCT01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course covers basic and targeted in-depth knowledge of cryptographic processes and the practical use of cryptographic systems. After an overview of cryptographic methods, hash functions, symmetric methods, and asymmetric methods are presented. The theoretical basics of selected procedures are taught and practically explained using simple examples. In addition, areas of application and application scenarios for cryptographic procedures are presented.

Course Outcomes

On successful completion, students will be able to

- give an overview of different classes of cryptographic systems.
- give a basic description of symmetric cryptographic methods, in particular One-Time Pad, DES, and AES, and describe their operating principles by means of simple, concrete examples.
- describe the basic hash functions.
- describe basic asymmetric cryptographic methods, especially RSA, and their operating principles by means of simple, concrete examples.
- describe the areas of application of cryptographic procedures and their application scenarios.

Contents

1. Protection Goals, Vulnerabilities, and Threats
   - 1.1 Protection Goals
   - 1.2 Vulnerabilities and Threats
2. Foundations of Cryptology and its Core Components
   - 2.1 Encoding
   - 2.2 Symmetrical Encryption
   - 2.3 Asymmetric Encryption
   - 2.4 One-way Functions and Cryptographic Hash Functions
3. Basic Cryptographic Applications
   - 3.1 Key Exchange and Hybrid Processes
   - 3.2 Digital Signature

Literature
Compulsory Reading
Further Reading ▪ Paar, C. & Pelzl, J. (2010). Understanding Cryptography. A Textbook for Students and Practitioners. Springer. ▪ Singh, S. (1999). The code book [electronic resource] : the science of secrecy from ancient Egypt to quantum cryptography (1. ed.). Anchor Books. ▪ Smart, N. P. (2016). Cryptography Made Simple. Springer.

Study Format Distance Learning

Study Format Distance Learning	**Course Type** Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study 110 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 20 h	**Self Test** 20 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests

Mobile Software Engineering

Module Code: DLBCSEMSE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Nils Kannengießer (Mobile Software Engineering I) / Dr. Christian Remfert (Mobile Software Engineering II)

Contributing Courses to Module

- Mobile Software Engineering I (DLBCSEMSE01)
- Mobile Software Engineering II (DLBCSEMSE02)

<table>
<tr><th colspan="2">Module Exam Type</th></tr>
<tr><td>Module Exam</td><td>Split Exam
<u>Mobile Software Engineering I</u>
• Study Format "On Campus": Exam, 90 Minutes
• Study Format "myStudies": Exam, 90 Minutes
• Study Format "Distance Learning": Exam, 90 Minutes
<u>Mobile Software Engineering II</u>
• Study Format "myStudies": Written Assessment: Project Report
• Study Format "On Campus": Written Assessment: Project Report
• Study Format "Distance Learning": Written Assessment: Project Report</td></tr>
<tr><td colspan="2">Weight of Module
see curriculum</td></tr>
</table>

Module Contents	
Mobile Software Engineering I ▪ Basics of mobile software development ▪ Android system architecture ▪ Development environment ▪ Core components of an Android app ▪ Interaction between application components ▪ Advanced techniques **Mobile Software Engineering II** Conception, implementation, and documentation of small, mobile applications on the basis of a concrete task.	
Learning Outcomes **Mobile Software Engineering I** On successful completion, students will be able to ▪ recognize the differences and peculiarities of software development for mobile systems and explain them. ▪ differentiate between different activities, roles, and risks in the creation, operation, and maintenance of mobile software systems. ▪ explain and differentiate between the architecture and technical features of the Android platform. ▪ independently create mobile software systems to solve concrete problems for the “Android” platform. **Mobile Software Engineering II** On successful completion, students will be able to ▪ independently design and create a prototype of a small mobile application to solve a specific problem. ▪ recognize typical problems and challenges in the practical implementation of small mobile applications. ▪ document the conception and implementation of small, independently designed and implemented mobile applications.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology fields

Mobile Software Engineering I

Course Code: DLBCSEMSE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Using the mobile platform "Android" as an example, it will be demonstrated how the programming of mobile applications (apps) differs from the development of browser-based information systems, which technologies and programming concepts are typically used, and which typical challenges there are in app development for industrial applications.

Course Outcomes

On successful completion, students will be able to

- recognize the differences and peculiarities of software development for mobile systems and explain them.
- differentiate between different activities, roles, and risks in the creation, operation, and maintenance of mobile software systems.
- explain and differentiate between the architecture and technical features of the Android platform.
- independently create mobile software systems to solve concrete problems for the “Android” platform.

Contents

1. Basics of Mobile Software Development
   - 1.1 Special Features of Mobile Devices
   - 1.2 Special Features of Mobile Software Development
   - 1.3 Classification of Mobile Devices
   - 1.4 The Android Platform
2. Android System Architecture
   - 2.1 The Android System
   - 2.2 Safety and Security
   - 2.3 Communication with Networks
3. Development Environment
   - 3.1 Android Studio
   - 3.2 First App and Emulator Test

3.3 Application Deployment

4. Core Components of an Android App
   4.1 Overview of the Components of an Android App
   4.2 Activities, Layouts, and Views
   4.3 Resources
   4.4 Summary in an App
   4.5 Graphic Design

5. Interaction Between Application Components
   5.1 Intents
   5.2 Services
   5.3 Broadcast Receiver

6. Advanced Techniques
   6.1 Threading
   6.2 Application Memory

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for absolute beginners: Getting started with mobile apps development using the Android Java SDK. Apress.
- Boyer, R., & Mew, K. (2016). Android application development cookbook (2nd ed.). Packt Publishing.
- Collins, L., & Ellis, R. S. (2015). Mobile devices: Tools and technologies. CRC Press.
- Hagos, T. (2020): Learn Android Studio 4: Efficient Java-Based Android Apps Development. Berkeley, CA: Apress.
- Meike, B. G., & Schiefer, L. (2022). Inside the Android OS: Building, customizing, managing, and operating Android system services. Pearson.

Study Format On Campus

Study Format	**Course Type**
On Campus	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Ses-sions/Learning Sprint ☑ Recorded Live Sessions

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Ses- sions/Learning Sprint ☑ Recorded Live Sessions

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Mobile Software Engineering II

Course Code: DLBCSEMSE02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Using the knowledge gained in the course "Mobile Software Engineering using the Android platform as an example", students independently create a mobile application and document its conception and implementation.

Course Outcomes

On successful completion, students will be able to

- independently design and create a prototype of a small mobile application to solve a specific problem.
- recognize typical problems and challenges in the practical implementation of small mobile applications.
- document the conception and implementation of small, independently designed and implemented mobile applications.

Contents

- Conception, implementation, and documentation of small, mobile applications on the basis of a concrete task. Possible topics are, for example:
- A radio app to improve the exchange between listeners and stations in general, and listeners and radio presenters in particular.
- An app that allows a group of board game fans to better organize their regular evening game.
- An app that theses supervisors at IUBH can use to improve their supervision processes.

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021): Android for Absolute Beginners [electronic resource]: Getting Started with Mobile Apps Development Using the Android Java SDK. Berkeley, CA: Apress.
- Boyer, R. & Mew, K. (2016): Android Application Development Cookbook - Second Edition. Birmingham, UK : Packt Publishing.
- Hagos, T. (2020): Learn Android Studio 4: Efficient Java-Based Android Apps Development. Berkeley, CA: Apress.

Study Format myStudies

Study Format myStudies	Course Type

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study 120 h	**Contact Hours** 0 h	**Tutorial/Tutorial Support** 30 h	**Self Test** 0 h	**Independent Study** 0 h	**Hours Total** 150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Study Format On Campus

Study Format	Course Type
On Campus	

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Foreign Language Italian

Module Code: DLFSWI_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Regina Cordes (Certificate Course Italian) / Prof. Dr. Regina Cordes (Foreign Language Italian)

Contributing Courses to Module
▪ Certificate Course Italian (DLFSWI01_E) ▪ Foreign Language Italian (DLFSI01_E)

<table>
<tr><th colspan="2">Module Exam Type</th></tr>
<tr><td>Module Exam</td><td>Split Exam
<u>Certificate Course Italian</u>
• Study Format "myStudies": Participation Certificate (passed / not passed)
• Study Format "Distance Learning": Participation Certificate (passed / not passed)
<u>Foreign Language Italian</u>
• Study Format "myStudies": Exam, 90 Minutes
• Study Format "Distance Learning": Exam, 90 Minutes</td></tr>
<tr><td colspan="2">Weight of Module
see curriculum</td></tr>
</table>

Module Contents
Certificate Course Italian To learn and deepen Italian as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language Italian** To learn and deepen Italian as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.

Learning Outcomes
Certificate Course Italian On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language Italian** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Certificate Course Italian

Course Code: DLFSWI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Italian as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

  - to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language Italian

Course Code: DLFSI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Italian as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)

- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	**Course Type**
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload

Self Study	Contact Hours	Tutorial/Tutorial Support	Self Test	Independent Study	Hours Total
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language French

Module Code: DLFSWF_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Regina Cordes (Certificate Course French) / Prof. Dr. Regina Cordes (Foreign Language French)

Contributing Courses to Module

- Certificate Course French (DLFSWF01_E)
- Foreign Language French (DLFSF01_E)

Module Exam Type

Module Exam	Split Exam
	Certificate Course French • Study Format "Distance Learning": Participation Certificate (passed / not passed) • Study Format "myStudies": Participation Certificate (passed / not passed) Foreign Language French • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents
Certificate Course French To learn and deepen French as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language French** To learn and deepen French as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.

Learning Outcomes
Certificate Course French On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language French** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Certificate Course French

Course Code: DLFSWF01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of French as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)
  - to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language French

Course Code: DLFSF01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of French as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)

- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language Spanish

Module Code: DLFSWS_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Regina Cordes (Certificate Course Spanish) / Prof. Dr. Regina Cordes (Foreign Language Spanish)

Contributing Courses to Module

- Certificate Course Spanish (DLFSWS01_E)
- Foreign Language Spanish (DLFSS01_E)

Module Exam Type	
Module Exam	**Split Exam** <u>Certificate Course Spanish</u> • Study Format "Distance Learning": Participation Certificate (passed / not passed) • Study Format "myStudies": Participation Certificate (passed / not passed) <u>Foreign Language Spanish</u> • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents	
Certificate Course Spanish To learn and deepen Spanish as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language Spanish** To learn and deepen Spanish as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.	
Learning Outcomes **Certificate Course Spanish** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language Spanish** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Languages	**Links to other Study Programs of the University** All Distance Learning Bachelor Programmes

Certificate Course Spanish

Course Code: DLFSWS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description
The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Spanish as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)
    - to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
    - Level A1 - present and past tenses, sentence structure, prepositions, etc.
    - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
    - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
    - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language Spanish

Course Code: DLFSS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Spanish as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language German

Module Code: DLFSWG

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Regina Cordes (Certificate Course German) / Prof. Dr. Regina Cordes (Foreign Language German)

Contributing Courses to Module
▪ Certificate Course German (DLFSWG01) ▪ Foreign Language German (DLFSG01)

Module Exam Type	
Module Exam	**Split Exam** Certificate Course German • Study Format "myStudies": Participation Certificate (passed / not passed) • Study Format "Distance Learning": Participation Certificate (passed / not passed) Foreign Language German • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents **Certificate Course German** To learn and deepen German as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language German** To learn and deepen German as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.

Learning Outcomes **Certificate Course German** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language German** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Certificate Course German

Course Code: DLFSWG01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of German as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)
  - to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language German

Course Code: DLFSG01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of German as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
    - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
    - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
    - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Industrial Robotics and Automation

Module Code: DLBROEIRA_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Handling Technology) / Aditya Mushyam (Automation Technology)

Contributing Courses to Module
▪ Handling Technology (DLBROEIRA01_E) ▪ Automation Technology (DLBROEIRA02_E)

Module Exam Type	
Module Exam	**Split Exam** <u>Handling Technology</u> • Study Format "Distance Learning": Exam, 90 Minutes <u>Automation Technology</u> • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents
Handling Technology ▪ Industrial Handling ▪ Delivery systems ▪ End effector/manipulator /Gripper ▪ Material flow **Automation Technology** ▪ Modern automation systems ▪ Programmable logic controllers ▪ Batch automation ▪ SCADA ▪ Industrial communications ▪ Distributed control systems ▪ Cyber-security

Learning Outcomes
Handling Technology On successful completion, students will be able to ▪ assign terms and elements to conventional and flexible automated handling and assembly technology. ▪ analyze processes in handling. ▪ design methods for the development of assembly and handling tasks. ▪ influence component design through analysis, so that production-ready design can commence in the course of the construction phase. **Automation Technology** On successful completion, students will be able to ▪ understand modern automation systems. ▪ identify trends and challenges. ▪ design an industrial automation system for an application. ▪ name relevant cyber-security issues.

Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the field of Engineering	All Bachelor Programs in the IT & Technology fields

Handling Technology

Course Code: DLBROEIRA01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In handling, a defined orientation of a geometrically defined object is either created or maintained for a limited time. Typical handling devices, such as industrial robots or handling devices, are program-controlled.This course provides an overview of the standards of conventional handling technology. In addition, the knowledge of flexible handling technology is deepened, with a focus on characteristic pick and place applications and Gripper / Manipulator / Endeffector technology.

Course Outcomes

On successful completion, students will be able to

- assign terms and elements to conventional and flexible automated handling and assembly technology.
- analyze processes in handling.
- design methods for the development of assembly and handling tasks.
- influence component design through analysis, so that production-ready design can commence in the course of the construction phase.

Contents

1. Introduction
   - 1.1 Definitions
   - 1.2 Requirements

2. Handling Objects
   - 2.1 Component Regulations
   - 2.2 Component Actions (Stability/Movement Sequences)
   - 2.3 Handling-Oriented Component Design
   - 2.4 Design for manufacturing and assembly

3. Handling Procedures
   - 3.1 Functions
   - 3.2 Illustrations
   - 3.3 Functional Diagrams

4. Standard and Delivery Systems
   - 4.1 Memory
   - 4.2 Motion Systems
   - 4.3 Delivery
   - 4.4 Branching
   - 4.5 Sorting
   - 4.6 Allocation
   - 4.7 Safety Equipment
   - 4.8 Control Systems

5. Flexible Handling Technology
   - 5.1 Tasks and Types (IR, Cobot)
   - 5.2 Pick and Place
   - 5.3 Drives
   - 5.4 Gripper technology

6. Transfer Systems
   - 6.1 Workpiece Carrier
   - 6.2 Chaining

7. Security
   - 7.1 Technical Safety Requirements
   - 7.2 Malfunction During Operation

Literature

Compulsory Reading

Further Reading

- Annals of Scientific Society for Assembly, Handling and Industrial Robotics 2021. (2022). Springer Nature.
- Khatib, O., & Siciliano, B. (2016). Springer handbook of robotics (2nd edition). Springer.
- Stephens, Matthew P. (2019). Manufacturing Facilities Design & Material Handling; Sixth Edition. Purdue University Press
- Schütz, Daniel/Wahl, Friedrich M. (2011). Robotic Systems for Handling and Assembly. (2011). Springer Tracts in Advanced Robotics. Berlin Heidelberg.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Automation Technology

Course Code: DLBROEIRA02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Automation technology refers to the analysis, design and improvement of existing or new automation systems. Modern automation systems are characterized by the combination of many different devices, such as actuators, sensors, machines, which must be able to perform a coordinate action and to exchange data with each other. This course introduces such modern automation systems by listing their necessary components, presenting current challenges and trends and explaining communication technologies to build effective industrial automation networks. A brief overview on the topic of cyber-security is also given.

Course Outcomes

On successful completion, students will be able to

- understand modern automation systems.
- identify trends and challenges.
- design an industrial automation system for an application.
- name relevant cyber-security issues.

Contents

1. Introduction
   - 1.1 Evolution of Automation
   - 1.2 Industrial Revolutions
   - 1.3 Modern Automation Systems
   - 1.4 Challenges and Trends

2. An Introduction to Programmable Logic Controllers
   - 2.1 Hardware
   - 2.2 Internal Architecture
   - 2.3 I/O
   - 2.4 Ladder and Functional Block Programming
   - 2.5 Programming Methods

3. Batch Automation
   - 3.1 Basics

Literature

Compulsory Reading

Further Reading

- Dey, C., & Sen, S. (2020). Industrial automation technologies. CRC.
- Gardner, R. F. (2020). Introduction to plant automation and controls. CRC.
- Lehto, M., & Neittaanmäki, P. (2015). Cyber security: Analytics, technology and automation. Springer.
- Mehta, B. R., & Reddy, Y. J. (2014). Industrial process automation systems: Design and implementation. Elsevier.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam

Service Robotics

Module Code: DLBROESR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Florian Simroth (Mobile Robotics) / Dr. Florian Simroth (Soft Robotics)

Contributing Courses to Module

- Mobile Robotics (DLBROESR01_E)
- Soft Robotics (DLBROESR02_E)

Module Exam Type

Module Exam	Split Exam
	Mobile Robotics • Study Format "Distance Learning": Written Assessment: Case Study Soft Robotics • Study Format "Distance Learning": Written Assessment: Written Assignment

Weight of Module

see curriculum

Module Contents
Mobile Robotics ▪ Locomotion ▪ Kinematics and dynamics ▪ Perception ▪ Mobile manipulators ▪ Path motion and task planning ▪ Localization and mapping **Soft Robotics** ▪ Soft robotics ▪ Actuators for soft robots ▪ Sensors for soft robots ▪ Applications of soft robots

Learning Outcomes
Mobile Robotics On successful completion, students will be able to ▪ understand mobile robot locomotion, kinematics, and dynamics. ▪ model and simulate a wheeled, legged, or aerial mobile robot. ▪ understand common approaches for localization and mapping. ▪ apply and simulate path, motion, and task planning algorithms. ▪ simulate and understand mobile manipulators. **Soft Robotics** On successful completion, students will be able to ▪ know the basics behind soft robots. ▪ understand and analyze common structures of soft robots. ▪ choose the best soft robot technology for a given application.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Mobile Robotics

Course Code: DLBROESR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Modern robots are mobile robots, able to move in spaces and perform tasks autonomously. This is for instance what is done by household robots, or by robots working in warehouses. In the last years, such robots have been improved by the implementation of advanced localization and task planning algorithms, which are based on the fundamentals of mobile robot kinematics and dynamics. This course starts with an introduction to the main concepts of robot locomotion, presenting the three main categories of mobile robots, namely legged, wheeled and aerial (often called drones). As second focus lies on the necessary mathematical foundation. This course, thus, discusses kinematics and dynamics of mobile robots. The topic of how a mobile robot can perceive the surrounding world is treated in detail in a third part of this course, where sensors for mobile robots are introduced together with an introduction on advanced topics such as robot vision and image processing. The last part of this course describes the main approaches for localization, mapping and motion and task planning. A brief overview on combination of mobile robots and manipulators, i.e., mobile manipulators, is also given.

Course Outcomes

On successful completion, students will be able to

- understand mobile robot locomotion, kinematics, and dynamics.
- model and simulate a wheeled, legged, or aerial mobile robot.
- understand common approaches for localization and mapping.
- apply and simulate path, motion, and task planning algorithms.
- simulate and understand mobile manipulators.

Contents

1. Locomotion
   - 1.1 Basics
   - 1.2 Legged Mobile Robots
   - 1.3 Wheeled Mobile Robots
   - 1.4 Aerial Mobile Robots

2. Kinematics
   - 2.1 Basics
   - 2.2 Kinematic Models and Constraints

Literature
Compulsory Reading
Further Reading ▪ Corke, P. (2017): Robotics, Vision and Control: Fundamental Algorithms In MATLAB. 2nd ed., Springer International Publishing, Cham. ▪ Siciliano, B./Khatib, O. (eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Cham. ▪ Siegwart, R./Nourbakhsh, I. R./Scaramuzza, D. (2011): Introduction to Autonomous Mobile Robots. The MIT Press, Cambridge, MS. ▪ Tzafestas, S. G. (2013): Introduction to Mobile Robot Control. Elsevier Inc, Amsterdam.

Study Format Distance Learning

Study Format Distance Learning	**Course Type** Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Soft Robotics

Course Code: DLBROESR02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Classic robots are made of rigid links and structures. In the last years, the field of robotics has been strongly influenced and inspired by biological processes. Instead of rigid structures, soft structures, materials, and surfaces are characterizing innovative, soft robots. This new generation of robots can be used in several applications where highly dynamic tasks must be performed in unsafe or rough environments, and especially where the interaction with humans is necessary. This course provides the basics in the fast-changing field of soft robotics, starting with an overview of materials and technologies for soft actuators, proceeding with an overview on innovative sensors, and concluding with an overview on modeling approaches for soft robots. The last part summarizes some relevant state-of-the-art applications.

Course Outcomes

On successful completion, students will be able to

- know the basics behind soft robots.
- understand and analyze common structures of soft robots.
- choose the best soft robot technology for a given application.

Contents

1. Introduction
   - 1.1 Soft Robots
   - 1.2 Challenges
   - 1.3 Trends
   - 1.4 Applications

2. Actuators
   - 2.1 Soft Actuators and Their Classification
   - 2.2 Materials and Properties of Soft Actuators
   - 2.3 Thermo-Driven Soft Actuators
   - 2.4 Electro-Driven Soft Actuators
   - 2.5 Light-Driven Soft Actuators
   - 2.6 Magneto-Driven Soft Actuators
   - 2.7 Pneumatic Soft Actuators

3. Sensors
    3.1 Basics
    3.2 Types of Sensors (With Examples)
    3.3 Sensing Technologies

4. Modeling and Control
    4.1 Basics
    4.2 Modeling of Soft Robots (With Examples)
    4.3 Control of Soft Robots (With Examples)

5. Concluding Remarks
    5.1 Applications
    5.2 Challenges and Opportunities
    5.3 Useful Research and Projects on Soft Robotics

Literature

Compulsory Reading

Further Reading

- Asaka, K./Okuzaki, H. (eds.) (2019): Soft actuators: materials, modeling, applications, and future perspectives. Springer, Singapore.
- Kim, J. (2017): Microscale Soft Robotics. Springer International Publishing, Cham.
- Siciliano, B./Khatib, O. (eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Cham.
- Verl, A., et al (eds.) (2015): Soft Robotics: Transferring Theory to Application. Soft Robotics. Springer, Berlin.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Written Assignment

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Online Tests ☑ Guideline

Cognitive Robotics

Module Code: DLBROECR

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Matthias Eifler (Digital Signal Processing) / Prof. Dr. Armin Grasnick (Introduction to Computer Vision)

Contributing Courses to Module

- Digital Signal Processing (DLBROEICR01_E)
- Introduction to Computer Vision (DLBAIICV01)

Module Exam Type

Module Exam	Split Exam
	Digital Signal Processing • Study Format "Distance Learning": Exam, 90 Minutes (50) Introduction to Computer Vision • Study Format "Distance Learning": Exam, 90 Minutes (100) • Study Format "myStudies": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents
Digital Signal Processing ▪ Signal Sampling and Quantization ▪ Digital Signals and Systems ▪ Discrete Fourier Transform ▪ Z-Transform ▪ Digital Signal Processing and Filters **Introduction to Computer Vision** ▪ Vision Fundamentals ▪ Image Filtering ▪ Low-Level Vision ▪ High-Level Vision ▪ Video

Learning Outcomes
Digital Signal Processing On successful completion, students will be able to ▪ analyze discrete time systems. ▪ apply analysis tools such as the Discrete Fourier Transform. ▪ apply the z-Transform. ▪ analyze properties of discrete systems. ▪ design finite and infinite impulse response filters. ▪ implement filters in hardware and software. **Introduction to Computer Vision** On successful completion, students will be able to ▪ remember important facts about image acquisition both in humans as well as technical systems. ▪ describe the importance of filtering in image processing and its practical application. ▪ know about the role and function of lower-level features such as edges or salient points in vision processing. ▪ explain how Deep Learning methods are successfully applied in high-level vision tasks. ▪ understand the particularities of video processing and know how to solve common problems related to the interpretation of video material.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Engineering and Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology field

Digital Signal Processing

Course Code: DLBROEICR01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Digital signal processing enables digital audio and video extraction, as well as extraction of important features from any other kind of signal, for instance medial imagery or diagnostic tools. This course provides the students with expertise on the theory and practice of digital signal processing. In the first part, theoretical concepts are introduced, presenting the main tools for analysis of digital, i.e., sampled or discrete-time systems. The core of digital signal processing resides in the design of a digital filter. The second part of the course focuses on different filter-design approaches, i.e. a discussion on finite impulse response and infinite impulse response filters. The last part gives important insights into the hardware and software implementation of digital signal processing, bridging theory with applied practice.

Course Outcomes

On successful completion, students will be able to

- analyze discrete time systems.
- apply analysis tools such as the Discrete Fourier Transform.
- apply the z-Transform.
- analyze properties of discrete systems.
- design finite and infinite impulse response filters.
- implement filters in hardware and software.

Contents

1. Introduction
   - 1.1 Basic Concepts
   - 1.2 Applications

2. Signal Sampling and Quantization
   - 2.1 Sampling
   - 2.2 Signal reconstruction
   - 2.3 Analog-to-digital Conversion
   - 2.4 Digital-to-Analog Conversion
   - 2.5 Quantization

3. Digital Signals and Systems

8.6 Applications

9. Hardware and Software for Digital Signal Processing
 9.1 Digital Signal Processor Architecture
 9.2 Digital Signal Processor Hardware Units
 9.3 Fixed-Point and Floating-Point Formats
 9.4 Implementation of FIR and IIR Filters in Fixed-Point
 9.5 DSP Programming Examples

Literature

Compulsory Reading

Further Reading

- Manolakis, D. G./Ingle, V. K. (2011): Applied digital signal processing: theory and practice. Cambridge University Press, Cambridge.
- Tan, L./Jiang, J. (2013): Digital signal processing: fundamentals and applications. 2nd ed., Academic Press, Cambridge, MS.
- Vetterli, M./Kovačević, J./Goyal, V. K. (2014): Foundations of signal processing. 2nd ed., Cambridge University Press, Cambridge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Introduction to Computer Vision

Course Code: DLBAIICV01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	None

Course Description

This course aims at laying the foundation in the understanding of Computer Vision. To this end, it starts with an introduction of the image acquisition process both from a biological as well as a technical perspective. Building upon that, the importance of filtering in image processing is explained and the necessary conceptual background is laid out. This enables the subsequent presentation of how crucial low-level features are generated from the raw image material. From there, the exposition moves on to describing current approaches to relevant high-level vision problems such as object recognition or image classification. Finally, the processing of video information is treated together with an exposition on modern approaches to solving salient Computer Vision tasks in this setting.

Course Outcomes

On successful completion, students will be able to

- remember important facts about image acquisition both in humans as well as technical systems.
- describe the importance of filtering in image processing and its practical application.
- know about the role and function of lower-level features such as edges or salient points in vision processing.
- explain how Deep Learning methods are successfully applied in high-level vision tasks.
- understand the particularities of video processing and know how to solve common problems related to the interpretation of video material.

Contents

1. Vision Fundamentals
   - 1.1 The Human Visual System
   - 1.2 Pinhole and Lens Cameras
   - 1.3 Image Sensors

2. Image Filtering
   - 2.1 Linear Shift Invariant Systems, Convolutions and the Point Spread Function
   - 2.2 Fourier Transform and Spatial Frequency
   - 2.3 Common Image Filters (Gaussian Smoothing, Median, Mode Filters, Rank Order)

3. Low-Level Vision
   - 3.1 Blobs
   - 3.2 Edges and Lines
   - 3.3 Corners and Points of Interest
4. High Level Vision
   - 4.1 Deep Learning
   - 4.2 Image Classification
   - 4.3 Semantic Segmentation
   - 4.4 Object Recognition
5. Video
   - 5.1 Fundamentals of Video Data, Motion and Optical Flow
   - 5.2 Object Tracking
   - 5.3 Action Classification

Literature

Compulsory Reading

Further Reading

- Davies E. R. (2018). Computer Vision (5th ed.). Academic Press.
- Forsyth, D. & Ponce, J. (2011). Computer vision: A modern approach. Pearson.
- Szeliski R. (2022). Computer Vision - Algorithms and Applications (2nd ed.). Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

AI Specialist

Module Code: DLBDSEAIS

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Kristina Schaaff (Artificial Intelligence) / N.N. (Project: Artificial Intelligence)

Contributing Courses to Module
▪ Artificial Intelligence (DLBDSEAIS01) ▪ Project: Artificial Intelligence (DLBDSEAIS02)

Module Exam Type	
Module Exam	**Split Exam** Artificial Intelligence • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "Duales myStudium": Exam, 90 Minutes Project: Artificial Intelligence • Study Format "Distance Learning": Portfolio • Study Format "Duales myStudium": Portfolio
Weight of Module see curriculum	

<table>
<tr><td colspan="2">

Module Contents

Artificial Intelligence

- History of AI
- Modern AI systems
- Reinforcement learning
- Natural language processing
- Computer vision

Project: Artificial Intelligence

This course focuses on developing a simple AI system for a specific application and domain. A current list of topics is located in the Learning Management System.

</td></tr>
<tr><td colspan="2">

Learning Outcomes

Artificial Intelligence

On successful completion, students will be able to

- chart the historical developments in artificial intelligence.
- understand the approach of contemporary AI systems.
- comprehend the concepts behind reinforcement learning.
- analyze natural language using basic NLP techniques.
- scrutinize images and their contents.

Project: Artificial Intelligence

On successful completion, students will be able to

- determine the requirements for building an artificial intelligence system.
- evaluate an application for an AI system.
- transfer theoretically-sound and practically-proven methods and tools to an application domain.
- create an AI system for a chosen application.

</td></tr>
<tr><td>

Links to other Modules within the Study Program

This module is similar to other modules in the fields of Data Science & Artificial Intelligence

</td><td>

Links to other Study Programs of the University

All Bachelor Programs in the IT & Technology fields

</td></tr>
</table>

Artificial Intelligence

Course Code: DLBDSEAIS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The quest for artificial intelligence (AI) has captured humanity's interest for many decades and has been an active research area since the 1960s. This course will give a detailed overview of the historical developments, successes, and set-backs in AI, as well as modern approaches in the development of artificial intelligence.This course gives an introduction to reinforcement learning, a process similar to how humans and animals experience the world: exploring the environment and inferring the best course of action.This course also covers the principles of natural language processing and computer vision, both of which are key ingredients for an artificial intelligence to be able to interact with its environment.

Course Outcomes

On successful completion, students will be able to

- chart the historical developments in artificial intelligence.
- understand the approach of contemporary AI systems.
- comprehend the concepts behind reinforcement learning.
- analyze natural language using basic NLP techniques.
- scrutinize images and their contents.

Contents

1. History of AI
   - 1.1 Historical Developments
   - 1.2 AI Winter
   - 1.3 Expert Systems
   - 1.4 Notable Advances

2. Modern AI Systems
   - 2.1 Narrow versus General AI
   - 2.2 Application Areas

3. Reinforcement Learning
   - 3.1 What is Reinforcement Learning?
   - 3.2 Markov Chains and Value Function

	3.3 Time-Difference and Q Learning
4.	Natural Language Processing (NLP)
	4.1 Introduction to NLP and Application Areas
	4.2 Basic NLP Techniques
	4.3 Vectorizing Data
5.	Computer Vision
	5.1 Introduction to Computer Vision
	5.2 Image Representation and Geometry
	5.3 Feature Detection
	5.4 Semantic Segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F., Barry, W., & Paradiso, M. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Chollet, F. (2018). Deep learning with Python. Manning.
- Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O’Reilly.
- Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems (2nd ed.). O’Reilly.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.
- Grus, J. (2019). Data science from scratch: First principles with Python. O’Reilly.
- Jurafsky, D., & Martin, J. H. (2022). Speech and language processing (3rd ed.). Prentice Hall.
- Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A modern approach (4th ed., global ed.). Pearson.
- Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). MIT Press. (Adaptive Computation and Machine Learning series).
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer. (Texts in Computer Science series).

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions		

Project: Artificial Intelligence

Course Code: DLBDSEAIS02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This project course will give students hands-on experience in the challenging task of designing and developing an AI system for a specific application and domain. Students will need to consider requirements and practical constraints as well as the desired output of the AI system.Following this course the students will get holistic overview of developing a specific AI-based application.

Course Outcomes

On successful completion, students will be able to

- determine the requirements for building an artificial intelligence system.
- evaluate an application for an AI system.
- transfer theoretically-sound and practically-proven methods and tools to an application domain.
- create an AI system for a chosen application.

Contents

- This project course focuses on understanding and implementing a simple AI system. Based on the course Artificial Intelligence (DLBDSEAI01), students will design and implement a simple AI system. In the first step, students will choose a specific application and domain and then use the methods from the course to analyze the requirements and outcomes before implementing their own AI application. All relevant artifacts and considerations are documented by the students in a course portfolio.

Literature
Compulsory Reading
Further Reading ▪ Bear, F./Barry, W./Paradiso, M. (2020): Neuroscience: Exploring the brain. 4th ed., Lippincott Williams and Wilkins, Baltimore, MD ▪ Geron, A. (2019): Hands-on machine learning with Scikit-Learn and TensorFlow. O'Reilly, Boston, MA. ▪ Goodfellow, I./Bengio, Y./Courville, A. (2016): Deep learning. MIT Press, Boston, MA. ▪ Grus, J. (2019): Data science from scratch: First principles with Python. O'Reilley, Sebastopol, CA. ▪ Chollet, F. (2018). Deep learning with Python. Manning. ▪ Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: concepts, tools, and techniques to build intelligent systems (Second edition). O'Reilly. ▪ Grus, J. (2019): Data science from scratch: First principles with Python. O'Reilley, Sebastopol, CA. ▪ Jurafsky, D., & Martin, J. H. (2022). Speech and language processing (3rd ed.). Prentice Hall. ▪ Russell, S. J., & Norvig, P. (2022). Artificial intelligence: a modern approach (Fourth edition, global edition). Pearson. ▪ Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed. 2022). Texts in computer science. Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Slides	☑ Guideline

Study Format Duales myStudium

Study Format	**Course Type**
Duales myStudium	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

Autonomous Driving

Module Code: DLBDSEAD

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	150 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Ha Ngo (Self-Driving Vehicles) / Ha Ngo (Seminar: Current Topics and Trends in Self-Driving Technology)

Contributing Courses to Module

- Self-Driving Vehicles (DLBDSEAD01)
- Seminar: Current Topics and Trends in Self-Driving Technology (DLBDSEAD02)

Module Exam Type

Module Exam	Split Exam
	Self-Driving Vehicles • Study Format "Duales myStudium": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes Seminar: Current Topics and Trends in Self-Driving Technology • Study Format "Distance Learning": Written Assessment: Research Essay • Study Format "Duales myStudium": Written Assessment: Research Essay

Weight of Module

see curriculum

Module Contents

Self-Driving Vehicles

- Safety standards
- Sensor fusion
- Computer vision
- Localization & motion
- Motion planning

Seminar: Current Topics and Trends in Self-Driving Technology

The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

Learning Outcomes

Self-Driving Vehicles

On successful completion, students will be able to

- cite relevant safety standards.
- grasp the concepts of sensors and sensor fusion.
- apply computer vision techniques to detect features.
- evaluate images in terms of semantic segmentation.
- understand motion models and localization approaches.
- utilize motion planning techniques.

Seminar: Current Topics and Trends in Self-Driving Technology

On successful completion, students will be able to

- transfer theoretical knowledge and methods to new domains.
- understand recent developments in self-driving vehicles.
- create new insights based on detailed studies of current research and technology.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Engineering	All Bachelor Programmes in the IT & Technology fields

Self-Driving Vehicles

Course Code: DLBDSEAD01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course focuses on the foundations of autonomous vehicles and starts with a detailed introduction to relevant safety standards in terms of functional and IT security.This course continues with a presentation of the concept of sensor fusion and discusses relevant aspects of computer vision techniques such as feature detection, calibration, and semantic segmentation.A large part of the course concerns localization and motion planning. Relevant motion models are introduced and localization techniques such as odometry, triangulation, and satellite-based systems are discussed in detail, along with path planning, motion prediction, and trajectory generation.

Course Outcomes

On successful completion, students will be able to

- cite relevant safety standards.
- grasp the concepts of sensors and sensor fusion.
- apply computer vision techniques to detect features.
- evaluate images in terms of semantic segmentation.
- understand motion models and localization approaches.
- utilize motion planning techniques.

Contents

1. Sensors
   - 1.1 Physical principles of sensors
   - 1.2 Types of sensors
   - 1.3 Sensor calibration
   - 1.4 Application scenarios

2. Sensor Fusion
   - 2.1 Elaborating data from sensors
   - 2.2 The Kalman filter
   - 2.3 Object tracking

3. Computer Vision
   - 3.1 Pixels and filters

3.2 Feature detection 3.3 Semantic segmentation 4. Localization & Motion 4.1 Motion models 4.2 Trilateration 4.3 Satellite-based localization 5. Motion planning 5.1 Mission planning 5.2 Behavior Planning 5.3 Local Planning 6. Safety Standards 6.1 Functional Safety 6.2 Safety of Intended Functionality 6.3 IT Security

Literature
Compulsory Reading
Further Reading ▪ Sciavicco, L., Villani, L., Oriolo, G., & Siciliano, B. (2009). Robotics : modelling, planning andcontrol. Springer. ▪ Thrun, S. (2002). Probabilistic robotics. Communications of the ACM, 45(3), 52-57. ▪ LaValle, S. M. (2006). Planning algorithms. Cambridge University Press. ▪ Watzenig, D., & Horn, M. (2016). Automated driving: Safer and more efficient future driving. Springer.

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

Tutorial Support	Learning Material	Exam Preparation
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Seminar: Current Topics and Trends in Self-Driving Technology

Course Code: DLBDSEAD02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description This courses focuses on recent developments in the field of self-driving vehicles. Following the course Self-Driving Vehicles (DLBDSEAD01), in this course students will focus on a particular topic in the context of autonomous driving, applying the knowledge they have obtained in the first course.Finally, a research essay will be written.
Course Outcomes On successful completion, students will be able to ▪ transfer theoretical knowledge and methods to new domains. ▪ understand recent developments in self-driving vehicles. ▪ create new insights based on detailed studies of current research and technology.
Contents ▪ The seminar covers current topics of autonomous vehicles. The choice of topics can include (but are not limited to) recent technical advances as well as philosophical issues or implications for society, law, or relevant industries.

Literature
Compulsory Reading
Further Reading ▪ Ben-Ari, M./Mondada, F. (2018): Elements of robotics. Springer, Cham. ▪ European Union. (2001): Directive 2001/95/EG. (Available on the Internet) ▪ Fisher, R. B., et al. (2016): Dictionary of computer vision and image processing. John Wiley & Sons, Chichester. ▪ Smith, D. J./Simpson, K. (2016): The safety critical systems handbook. 4th ed., Elsevier, Oxford. ▪ Smith, D. J. (2017): Reliability, maintainability, and risk. 9th ed., Elsevier, Oxford. ▪ Society of Automobile Engineers International. (2012): SAE J3061. (Available on the Internet) ▪ Szelski, R. (2022): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden. ▪ Wang, P. K.-C. (2015): Visibility-based optimal path and motion planning (vol. 568). Springer, Cham.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Seminar

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Guideline

Data Science and Deep Learning

Module Code: DLBROEDSDL_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Gereon Wellmann (Data Analytics and Big Data) / Dr. Lino Antoni Giefer (Deep Learning)

Contributing Courses to Module

- Data Analytics and Big Data (DLBINGDABD01_E)
- Deep Learning (DLBDBDL01_E)

Module Exam Type

Module Exam	Split Exam
	<u>Data Analytics and Big Data</u> • Study Format "myStudies": Written Assessment: Case Study • Study Format "Distance Learning": Written Assessment: Case Study <u>Deep Learning</u> • Study Format "Distance Learning": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents

Data Analytics and Big Data

- Introduction to Data Analysis
- Statistical Basics
- Data Mining
- Big Data Methods and Technologies
- Legal Aspects of Data Analysis
- Solution Scenarios
- Application of Big Data in the Industry

Deep Learning

- Introduction
- Introduction to Neural Networks
- Training Neural Networks
- Introduction to Deep Learning Frameworks
- Classification and Optimization
- Multilayer Neural Networks
- Convolutional Neural Networks

Learning Outcomes	
Data Analytics and Big Data On successful completion, students will be able to ▪ distinguish between information and data and know the meaning of these terms for decision-making. ▪ derive the Big Data issue, especially in connection with Internet of Things, and describe it using examples. ▪ identify basics from statistics, which are necessary for the analysis of large data sets. ▪ identify the process of data mining and classify different methods in it. ▪ identify selected methods and technologies that are used in the Big Data context and apply them to simple examples. ▪ recognize the legal framework for the application of data analysis in Germany and internationally. ▪ identify the specific prospects and challenges of applying Big Data analyses in industry. **Deep Learning** On successful completion, students will be able to ▪ place concepts of deep learning in the context of machine learning and artificial intelligence. ▪ define different types of regression and explain the implementation of logistic regression with perceptrons. ▪ explain the structure and function of simple neural networks. ▪ explain concepts and interrelationships in training of neural networks and to partially implement these concepts. ▪ differentiate between deep learning frameworks. ▪ implement, train and optimize neural networks with the help of a Deep Learning Framework ▪ understand the structure and functioning of Convolutional Neural Networks and train them using a Deep Learning Framework.	
Links to other Modules within the Study Program	**Links to other Study Programs of the University**
This module is similar to other modules in the fields of Data Science & Artificial Intelligence	All Bachelor Programmes in the IT & Technology fields

Data Analytics and Big Data

Course Code: DLBINGDABD01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The aim of the course is to familiarize students with selected methods and techniques of data analysis in the context of continuously increasing, heterogeneous data sets. To this end, the fundamental relevance of Big Data methods is presented by drawing on the historical development of stored data. One decisive factor here is the continuous transmission Internet of Things sensor data to other systems. This is followed by a short introduction to the essential statistical fundamentals before the individual steps of the data mining process are discussed. In distinction to these classical procedures, selected methods are presented with which stored data in the Big Data context can be made analyzable. As data analysis is subject to certain legal frameworks, this course also covers legal aspects such as data protection. The course concludes with an overview of the practical application of Big Data methods and tools. In particular, fields of application in the industrial context are examined.

Course Outcomes

On successful completion, students will be able to

- distinguish between information and data and know the meaning of these terms for decision-making.
- derive the Big Data issue, especially in connection with Internet of Things, and describe it using examples.
- identify basics from statistics, which are necessary for the analysis of large data sets.
- identify the process of data mining and classify different methods in it.
- identify selected methods and technologies that are used in the Big Data context and apply them to simple examples.
- recognize the legal framework for the application of data analysis in Germany and internationally.
- identify the specific prospects and challenges of applying Big Data analyses in industry.

Contents

1. Introduction to Data Analysis
   - 1.1 Decisions, Information, Data
   - 1.2 Historical Development of Data Storage and Evaluation
   - 1.3 Big Data: Features and Examples
   - 1.4 Data Analysis

Literature
Compulsory Reading
Further Reading ▪ Akerkar, R., & Srinivas Sajja, P. (2016). Intelligent Techniques for Data Science. Springer. ▪ Curry, E., Auer, S., Berre, A., J., Metzger, A., Perez, M., S., & Zillner, S. (2022). Technologies and Applications for big data value. Springer. Pages 1–15 & 321–344. ▪ Hoeren, T., & Kolany-Raiser, B., (Eds.). (2018). Big data in context – Legal, social and technological insights. Springer Nature. ▪ Illowsky, B., & Dean, S. (2018). Introductory statistics. OpenStax CNX. Chapters 2 & 8. ▪ Jurafsky, D., & Martin, J. H. (2013). Speech and language processing: an introduction to natural language processing, computational linguistics, and speech recognition (2. ed.). Pearson Prentice Hall.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Online Tests ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Online Tests ☑ Guideline

Deep Learning

Course Code: DLBDBDL01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Owing to recent technological advances, some concepts and methods from artificial intelligence can now be applied in practice. A major concept affected by this progress are neural networks. Thanks to fast and inexpensive GPUs on the one hand and freely available and well-documented frameworks on the other hand, neural networks are used today to solve many different problems, from pattern recognition in text and images to the automated assessment of insurance claims. In this course, students are introduced to the basics of this technology and enabled to apply it using simple examples.

Course Outcomes

On successful completion, students will be able to

- place concepts of deep learning in the context of machine learning and artificial intelligence.
- define different types of regression and explain the implementation of logistic regression with perceptrons.
- explain the structure and function of simple neural networks.
- explain concepts and interrelationships in training of neural networks and to partially implement these concepts.
- differentiate between deep learning frameworks.
- implement, train and optimize neural networks with the help of a Deep Learning Framework
- understand the structure and functioning of Convolutional Neural Networks and train them using a Deep Learning Framework.

Contents

1. Introduction
   - 1.1 AI
   - 1.2 Machine Learning
   - 1.3 Deep Learning
   - 1.4 Deep Learning Frameworks

2. Introduction to Neural Networks
   - 2.1 Linear Regression
   - 2.2 Logistic Regression
   - 2.3 Perceptrons

Literature
Compulsory Reading
Further Reading ▪ Alpaydin, E. (2008): Maschinelles Lernen. Oldenbourg Wissenschaftsverlag, München. ▪ Géron, A. (2017): Praxiseinstieg Machine Learning mit Scikit-Learn und TensorFlow. Konzepte, Tools und Techniken für intelligente Systeme. O'Reilly. ▪ Rashid, T. (2017): Neuronale Netze selbst programmieren. Ein verständlicher Einstieg mit Python. O'Reilly. ▪ Russel, S. (2012): Künstliche Intelligenz – Ein moderner Ansatz. Pearson, Hallbergmoos. ▪ Zhang, Y./Wallace, B. (2016): A Sensitivity Analysis of (and Practitioners' Guide to) Convolutional Neural Networks for Sentence Classification. In: Proceedings of the Eighth International Joint Conference on Natural Language Processing, IJCNLP 2017. Asian Federation of Natural Language Processing Taipei, Taiwan.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
	☑ Audio	
	☑ Slides	

Python for Software Engineering

Module Code: DLBROEPSE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum		BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Max Pumperla (Object Oriented and Functional Programming in Python) / Prof. Dr. Max Pumperla (Data Science Software Engineering)

Contributing Courses to Module

- Object Oriented and Functional Programming in Python (DLBDSOOFPP01)
- Data Science Software Engineering (DLBDSDSSE01)

Module Exam Type

Module Exam	Split Exam
	<u>Object Oriented and Functional Programming in Python</u> • Study Format "Distance Learning": Portfolio • Study Format "myStudies": Portfolio <u>Data Science Software Engineering</u> • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "On Campus": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents

Object Oriented and Functional Programming in Python

This course introduces the students to the advanced programming concepts of object orientation and functional programming and how they are realized in the Python programming language.

Data Science Software Engineering

- Traditional project management
- Agile project management
- Testing
- Software development paradigms
- From model to production

Learning Outcomes

Object Oriented and Functional Programming in Python

On successful completion, students will be able to

- explain basic notions in object-oriented programming such as functions and classes.
- understand object-oriented programming concepts and their relation to software design and engineering.
- describe advanced function concepts in Python.
- recognize important ideas from functional programming.
- recall important libraries for functional programming in Python.

Data Science Software Engineering

On successful completion, students will be able to

- understand the concept of project management approaches.
- apply agile approaches in software development.
- create automated software tests.
- understand various software development paradigms.
- evaluate the necessary steps to bring models into a production environment.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Data Science & Artificial Intelligence	All Bachelor Programs in the IT & Technology fields

Object Oriented and Functional Programming in Python

Course Code: DLBDSOOFPP01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description
This course builds upon basic knowledge of Python programming (Introduction to Programming with Python, DLBDSIPWP) and is concerned with the exposition of advanced Python programming concepts. To this end, important notions of object-oriented programming like classes and objects and pertaining design principles are outlined. Starting from an in-depth discussion of advanced features of Python functions, functional programming concepts and their implementation in Python are conveyed.

Course Outcomes

On successful completion, students will be able to

- explain basic notions in object-oriented programming such as functions and classes.
- understand object-oriented programming concepts and their relation to software design and engineering.
- describe advanced function concepts in Python.
- recognize important ideas from functional programming.
- recall important libraries for functional programming in Python.

Contents

- This course provides students with a thorough introduction to important notions and concepts from the domain of object-oriented programming such as classes, objects, abstraction, encapsulation, inheritance, polymorphism, composition, and delegation. Additionally, the functional programming paradigm and pertaining ideas like functions as first class objects, decorators, pure functions, immutability and higher order functions are conveyed. Pursuant to the portfolio course type, the aforementioned concepts and ideas are explored by hands-on programming projects.

Literature
Compulsory Reading
Further Reading ▪ Lott, S. F. (2018): Functional Python programming: Discover the power of functional programming, generator functions, lazy evaluation, the built-in itertools library, and monads. 2nd ed., Packt Publishing, Birmingham. ▪ Lutz, M. (2013): Learning Python. 5th ed., O'Reilly. ▪ Phillips, D. (2018): Python 3 object-oriented programming: Build robust and maintainable software with object-oriented design patterns in Python 3.8. 3rd ed., Packt Publishing. ▪ Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Study Format myStudies

Study Format	Course Type
myStudies	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Data Science Software Engineering

Course Code: DLBDSDSSE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBDSIPWP01 or DLBDSIPWP01_D; DLBDSOOFPP01 or IOBP01

Course Description

A core part of data science is creating value from data. This means not only the creation of sophisticated predictive models but also the development of these models according to modern software development principles.This course gives a detailed overview of the relevant methods and paradigms which data scientists need to know in order to develop enterprise-grade models.This course discusses traditional and agile project management techniques, highlighting both the Kanban and Scrum approaches. It explores relevant software development paradigms such as test-driven development, pair programming, mob programming, and extreme programming.Special focus is given to the topic of testing and the consideration of how to bring a model into a production environment.

Course Outcomes

On successful completion, students will be able to

- understand the concept of project management approaches.
- apply agile approaches in software development.
- create automated software tests.
- understand various software development paradigms.
- evaluate the necessary steps to bring models into a production environment.

Contents

1. Traditional Project Management
   - 1.1 Requirements engineering
   - 1.2 Waterfall model
   - 1.3 Rational unified process
2. Agile Project Management
   - 2.1 Criticism of the waterfall model
   - 2.2 Introduction to SCRUM
   - 2.3 Introduction to Kanban
3. Testing
   - 3.1 Why testing?

3.2 Unit trests
3.3 Integration tests
3.4 Performance monitoring

4. Software Development Paradigms
   4.1 Test-driven development (TDD)
   4.2 Pair programming
   4.3 Mob programming
   4.4 Extreme programming

5. From Model to Production
   5.1 Continuous delivery
   5.2 Continuous integration
   5.3 Building a scalable environment

Literature

Compulsory Reading

Further Reading

- Brookshear, G., & Brylow, D. (2019). Computer science: An overview. Pearson Education.
- Stephens, R. (2015). Beginning software engineering. John Wiley & Sons.

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book ☑ Video ☑ Audio ☑ Slides	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format On Campus

Study Format	Course Type
On Campus	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

IT Security

Module Code: DLBROEITS-01_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Ralf Kneuper (Introduction to Data Protection and Cyber Security) / Prof. Dr. Ralf Kneuper (Cryptography)

Contributing Courses to Module

- Introduction to Data Protection and Cyber Security (DLBCSIDPITS01)
- Cryptography (DLBCSCT01-01)

Module Exam Type

Module Exam	Split Exam
	<u>Introduction to Data Protection and Cyber Security</u> • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes <u>Cryptography</u> • Study Format "Distance Learning": Written Assessment: Case Study • Study Format "myStudies": Written Assessment: Case Study

Weight of Module

see curriculum

Module Contents

Introduction to Data Protection and Cyber Security

- Fundamentals of IT Security
- Data Protection
- IT Security Management
- Network and Communication Security

Cryptography

- Protection Targets, Vulnerabilities, and Threats
- Foundations of Cryptology and Its Core Components
- Basic Cryptographic Applications
- Authentication
- Single Computer Security
- Security Communication Network
- Security E-commerce
- Secure Software Development

Learning Outcomes

Introduction to Data Protection and Cyber Security

On successful completion, students will be able to

- explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area.
- cite the legal regulations on data protection and explain their implementation.
- discuss in-depth IT security management and suitable measures for implementation.
- use their overview knowledge of activities and strategies for IT security in software and system development.

Cryptography

On successful completion, students will be able to

- give an overview of different classes of cryptographic systems.
- give a basic description of symmetric cryptographic methods, in particular One-Time Pad, DES, and AES, and describe their operating principles by means of simple, concrete examples.
- describe the basic hash functions.
- describe basic asymmetric cryptographic methods, especially RSA, and their operating principles by means of simple, concrete examples.
- describe the areas of application of cryptographic procedures and their application scenarios.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the fields of Computer Science & Software Development	All Bachelor Programs in the IT & Technology fields

Introduction to Data Protection and Cyber Security

Course Code: DLBCSIDPITS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In this course, the students are familiarized with important concepts from the field of IT security. Basic terms are introduced and discussed, and typical application fields, areas of IT security application, and typical procedures and techniques are introduced and described.

Course Outcomes

On successful completion, students will be able to

- explain the terms and concepts of IT security and know the typical procedures and techniques which exist in each area.
- cite the legal regulations on data protection and explain their implementation.
- discuss in-depth IT security management and suitable measures for implementation.
- use their overview knowledge of activities and strategies for IT security in software and system development.

Contents

1. Fundamentals of Data Protection and Cyber Security
   - 1.1 Conceptual Bases, Protection Goals
   - 1.2 Attacks and Threats
   - 1.3 Security Strategy
   - 1.4 Legal Regulations

2. Data Protection
   - 2.1 Data Protection as a Personal Right
   - 2.2 Basic Principles of Data Protection
   - 2.3 EU General Data Protection Regulation
   - 2.4 Further International Regulations on Data Protection
   - 2.5 Cross-Border Data Flow
   - 2.6 Data Protection in Everyday Life

3. Basic Functions of Cyber Security and Their Implementation
   - 3.1 Identification and Authentication
   - 3.2 Rights Management

3.3 Rights Check
3.4 Preservation of Evidence

4. Cyber Security Management
   4.1 Basic Concepts and Standards in Cyber Security Management
   4.2 Series of Standards ISO 2700x

5. Cyber Security Management in Everyday Life
   5.1 Password Management
   5.2 Data Backup
   5.3 Email Security
   5.4 Protection Against Viruses and Other Malware
   5.5 Protection Against Social Engineering Attacks

6. Network and Communication Security
   6.1 Firewall Technology
   6.2 Network Separation
   6.3 Security in WLAN, Mobile Networks, Bluetooth, and NFC

7. Cyber Security in the Development of Software and Systems
   7.1 Protection of the Development Environment
   7.2 Secure Development
   7.3 Common Criteria

Literature

Compulsory Reading

Further Reading

- Arnold, R. (2017). Cybersecurity: A business solution. An executive perspective on managing cyber risk. Threat Sketch.
- European Parliament and Council of the European Union. (2016). EU General Data Protection Regulation (GDPR): Regulation 2016/679 of the European Parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union. Chapters 1—3 .
- Mattord, H., & Whitman, M. (2017). Management of information security. Cengage.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Practice Exam
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Online Tests
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Cryptography

Course Code: DLBCSCT01-01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

This course covers basic and targeted in-depth knowledge of cryptographic processes and the practical use of cryptographic systems. After an overview of cryptographic methods, hash functions, symmetric methods, and asymmetric methods are presented. The theoretical basics of selected procedures are taught and practically explained using simple examples. In addition, areas of application and application scenarios for cryptographic procedures are presented.

Course Outcomes

On successful completion, students will be able to

- give an overview of different classes of cryptographic systems.
- give a basic description of symmetric cryptographic methods, in particular One-Time Pad, DES, and AES, and describe their operating principles by means of simple, concrete examples.
- describe the basic hash functions.
- describe basic asymmetric cryptographic methods, especially RSA, and their operating principles by means of simple, concrete examples.
- describe the areas of application of cryptographic procedures and their application scenarios.

Contents

1. Protection Goals, Vulnerabilities, and Threats
   - 1.1 Protection Goals
   - 1.2 Vulnerabilities and Threats
2. Foundations of Cryptology and its Core Components
   - 2.1 Encoding
   - 2.2 Symmetrical Encryption
   - 2.3 Asymmetric Encryption
   - 2.4 One-way Functions and Cryptographic Hash Functions
3. Basic Cryptographic Applications
   - 3.1 Key Exchange and Hybrid Processes
   - 3.2 Digital Signature

Literature
Compulsory Reading
Further Reading ▪ Paar, C. & Pelzl, J. (2010). Understanding Cryptography. A Textbook for Students and Practitioners. Springer. ▪ Singh, S. (1999). The code book [electronic resource] : the science of secrecy from ancient Egypt to quantum cryptography (1. ed.). Anchor Books. ▪ Smart, N. P. (2016). Cryptography Made Simple. Springer.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	
☑ Recorded Live Sessions	☑ Audio	
	☑ Slides	

Mobile Software Engineering

Module Code: DLBCSEMSE

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Nils Kannengießer (Mobile Software Engineering I) / Dr. Christian Remfert (Mobile Software Engineering II)

Contributing Courses to Module
▪ Mobile Software Engineering I (DLBCSEMSE01) ▪ Mobile Software Engineering II (DLBCSEMSE02)

Module Exam Type	
Module Exam	**Split Exam** <u>Mobile Software Engineering I</u> • Study Format "On Campus": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes <u>Mobile Software Engineering II</u> • Study Format "myStudies": Written Assessment: Project Report • Study Format "On Campus": Written Assessment: Project Report • Study Format "Distance Learning": Written Assessment: Project Report
Weight of Module see curriculum	

Module Contents	
Mobile Software Engineering I ▪ Basics of mobile software development ▪ Android system architecture ▪ Development environment ▪ Core components of an Android app ▪ Interaction between application components ▪ Advanced techniques **Mobile Software Engineering II** Conception, implementation, and documentation of small, mobile applications on the basis of a concrete task.	
Learning Outcomes **Mobile Software Engineering I** On successful completion, students will be able to ▪ recognize the differences and peculiarities of software development for mobile systems and explain them. ▪ differentiate between different activities, roles, and risks in the creation, operation, and maintenance of mobile software systems. ▪ explain and differentiate between the architecture and technical features of the Android platform. ▪ independently create mobile software systems to solve concrete problems for the “Android” platform. **Mobile Software Engineering II** On successful completion, students will be able to ▪ independently design and create a prototype of a small mobile application to solve a specific problem. ▪ recognize typical problems and challenges in the practical implementation of small mobile applications. ▪ document the conception and implementation of small, independently designed and implemented mobile applications.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Computer Science & Software Development	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology fields

Mobile Software Engineering I

Course Code: DLBCSEMSE01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Using the mobile platform "Android" as an example, it will be demonstrated how the programming of mobile applications (apps) differs from the development of browser-based information systems, which technologies and programming concepts are typically used, and which typical challenges there are in app development for industrial applications.

Course Outcomes

On successful completion, students will be able to

- recognize the differences and peculiarities of software development for mobile systems and explain them.
- differentiate between different activities, roles, and risks in the creation, operation, and maintenance of mobile software systems.
- explain and differentiate between the architecture and technical features of the Android platform.
- independently create mobile software systems to solve concrete problems for the “Android” platform.

Contents

1. Basics of Mobile Software Development
   - 1.1 Special Features of Mobile Devices
   - 1.2 Special Features of Mobile Software Development
   - 1.3 Classification of Mobile Devices
   - 1.4 The Android Platform
2. Android System Architecture
   - 2.1 The Android System
   - 2.2 Safety and Security
   - 2.3 Communication with Networks
3. Development Environment
   - 3.1 Android Studio
   - 3.2 First App and Emulator Test

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021). Android for absolute beginners: Getting started with mobile apps development using the Android Java SDK. Apress.
- Boyer, R., & Mew, K. (2016). Android application development cookbook (2nd ed.). Packt Publishing.
- Collins, L., & Ellis, R. S. (2015). Mobile devices: Tools and technologies. CRC Press.
- Hagos, T. (2020): Learn Android Studio 4: Efficient Java-Based Android Apps Development. Berkeley, CA: Apress.
- Meike, B. G., & Schiefer, L. (2022). Inside the Android OS: Building, customizing, managing, and operating Android system services. Pearson.

Study Format On Campus

Study Format	Course Type
On Campus	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	**Learning Material** ☑ Course Book ☑ Video ☑ Audio ☑ Slides	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Mobile Software Engineering II

Course Code: DLBCSEMSE02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

Using the knowledge gained in the course "Mobile Software Engineering using the Android platform as an example", students independently create a mobile application and document its conception and implementation.

Course Outcomes

On successful completion, students will be able to

- independently design and create a prototype of a small mobile application to solve a specific problem.
- recognize typical problems and challenges in the practical implementation of small mobile applications.
- document the conception and implementation of small, independently designed and implemented mobile applications.

Contents

- Conception, implementation, and documentation of small, mobile applications on the basis of a concrete task. Possible topics are, for example:
- A radio app to improve the exchange between listeners and stations in general, and listeners and radio presenters in particular.
- An app that allows a group of board game fans to better organize their regular evening game.
- An app that theses supervisors at IUBH can use to improve their supervision processes.

Literature

Compulsory Reading

Further Reading

- Allen, G. (2021): Android for Absolute Beginners [electronic resource]: Getting Started with Mobile Apps Development Using the Android Java SDK. Berkeley, CA: Apress.
- Boyer, R. & Mew, K. (2016): Android Application Development Cookbook - Second Edition. Birmingham, UK : Packt Publishing.
- Hagos, T. (2020): Learn Android Studio 4: Efficient Java-Based Android Apps Development. Berkeley, CA: Apress.

Study Format myStudies

Study Format	Course Type
myStudies	

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Study Format On Campus

Study Format On Campus	Course Type

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint	☑ Slides	☑ Guideline

Internship

Module Code: FSINTER

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	None		10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Andreas Simon (Internship)

Contributing Courses to Module

- Internship (FSINTER01)

Module Exam Type

Module Exam	Split Exam
Study Format: myStudies Internship Reflection Paper (passed / not passed) Study Format: Distance Learning Internship Reflection Paper (passed / not passed)	

Weight of Module

see curriculum

Module Contents

Internship according to the Internship Regulations of the IU.

Learning Outcomes	
Internship On successful completion, students will be able to ▪ apply skills and knowledge they have obtained previously during their study program in an entrepreneurial environment. ▪ develop his / her practical and analytical skills in order to improve his / her employability. ▪ have practical knowledge and learn to work within an organization. ▪ acquire a first deep insight into organizational structures and communication procedures. ▪ apply comminication skills, socials skills, problem solving, time and project management which will shape their general management skills. ▪ shape their personality with the help of the interdisciplinary nature of the course especially in the area of the key qualifications like interpersonal skills or intercultural skills.	
Links to other Modules within the Study Program Builds on modules of the chosen degree program	**Links to other Study Programs of the University** All myStudies programs

Internship

Course Code: FSINTER01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
	English		10	None

Course Description

This module consists of two parts: (1) preparation tutorials and (2) the internship itself. During the preparation tutorials, students will learn about the intention of the internship and about the intellectual as well as social requirements of the working environment.

Course Outcomes

On successful completion, students will be able to

- apply skills and knowledge they have obtained previously during their study program in an entrepreneurial environment.
- develop his / her practical and analytical skills in order to improve his / her employability.
- have practical knowledge and learn to work within an organization.
- acquire a first deep insight into organizational structures and communication procedures.
- apply comminication skills, socials skills, problem solving, time and project management which will shape their general management skills.
- shape their personality with the help of the interdisciplinary nature of the course especially in the area of the key qualifications like interpersonal skills or intercultural skills.

Contents

- Internship according to the Internship Regulations of the IU.

Literature

Compulsory Reading

Further Reading

- Sweitzer, F. H. & King, M. A. (2009). The Successful Internship: Personal, Professional, and Civic Development. 3rd ed.. Cengage. ISBN: 0-495-59642-6.
- Kaser, K., Brooks, J. R. & Brooks, K. (2007). Making the Most of your Internship. Thomson. ISBN: 0-538-44432-0.
- Myers Kiser, P. (2008). The Human Services Internship: Getting the Most from your Experience. 2nd ed.. Cengage. ISBN: 0-495-09226-6.

Study Format myStudies

Study Format	Course Type
myStudies	

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Internship Reflection Paper (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	300 h	300 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Ses- sions/Learning Sprint ☑ Recorded Live Sessions

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Internship Reflection Paper (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	300 h	300 h

Instructional Methods
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions

Studium Generale

Module Code: DLBSG_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Studium Generale I) / N.N. (Studium Generale II)

Contributing Courses to Module

- Studium Generale I (DLBSG01_E)
- Studium Generale II (DLBSG02_E)

Module Exam Type

Module Exam	Split Exam
	Studium Generale I • Study Format "myStudies": See Selected Course • Study Format "Distance Learning": See Selected Course Studium Generale II • Study Format "Distance Learning": See Selected Course • Study Format "myStudies": See Selected Course

Weight of Module

see curriculum

Module Contents
Studium Generale I In principle, all IU bachelor courses can be selected as courses for the "Studium Generale", so that the content can be chosen from the entire breadth of the IU distance learning program. **Studium Generale II** In principle, all IU bachelor courses can be selected as courses for the "Studium Generale", so that the content can be chosen from the entire breadth of the IU distance learning program.

Learning Outcomes
Studium Generale I On successful completion, students will be able to ▪ apply acquired key competencies to issues in their field of study and/or in their professional environment. ▪ to deepen one's own skills and abilities in a self-directed manner. ▪ to look beyond the boundaries of their own area of expertise. **Studium Generale II** On successful completion, students will be able to ▪ apply acquired key competencies to issues in their field of study and/or in their professional environment. ▪ to deepen one's own skills and abilities in a self-directed manner. ▪ to look beyond the boundaries of their own area of expertise.

Links to other Modules within the Study Program	Links to other Study Programs of the University
It is a stand-alone offering with possible references to various required and elective modules	All IU Distance Learning Bachelor Programs

Studium Generale I

Course Code: DLBSG01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In the course "Studium Generale I", students deepen their knowledge in a self-selected subject area by completing an IU course outside their applicable curriculum. This gives them the opportunity to look beyond their own subject area and acquire further competencies. The associated option enables students to self-determine their study content to focus even more on issues relevant to them and/or to strengthen or develop selected competencies.

Course Outcomes

On successful completion, students will be able to

- apply acquired key competencies to issues in their field of study and/or in their professional environment.
- to deepen one's own skills and abilities in a self-directed manner.
- to look beyond the boundaries of their own area of expertise.

Contents

- The course "Studium Generale I" offers students the opportunity to take courses outside of their curriculum and the result can be credited as an elective subject. In principle, all IU bachelor courses that fulfill the following requirements are creditable for this purpose:
  - They are not part of an integral part of the applicable mandatory curriculum.
  - They do not have admission requirements or students can prove that they have met the admission requirement.
- The examination of the selected courses must be taken in full and finally passed in order to be credited as part of the 'Studium Generale' .

Literature

Compulsory Reading

Further Reading

- See course description of the selected course

Study Format myStudies

Study Format	Course Type
myStudies	See Selected Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	See Selected Course

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	0 h	0 h

Instructional Methods
see selected course

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	See Selected Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	See Selected Course

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	0 h	0 h

Instructional Methods
See Selected Course

Studium Generale II

Course Code: DLBSG02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In the course "Studium Generale II", students deepen their knowledge in a self-selected subject area by completing an IU course outside their applicable curriculum. This gives them the opportunity to look beyond their own subject area and acquire further competencies. The associated option enables students to self-determine their study content to focus even more on issues relevant to them and/or to strengthen or develop selected competencies.

Course Outcomes

On successful completion, students will be able to

- apply acquired key competencies to issues in their field of study and/or in their professional environment.
- to deepen one's own skills and abilities in a self-directed manner.
- to look beyond the boundaries of their own area of expertise.

Contents

- The course "Studium Generale II" offers students the opportunity to take courses outside of their curriculum and the result can be credited as an elective subject. In principle, all IU bachelor courses that fulfill the following requirements can be chosen for this purpose:
  - They are not part of an integral part of the applicable mandatory curriculum.
  - They do not have admission requirements or students can prove that they have met the admission requirement.
- The examination of the selected courses must be taken in full and finally passed in order to be credited as part of the 'Studium Generale' .

Literature

Compulsory Reading

Further Reading

- See course description of the selected course

Study Format Distance Learning

Study Format	Course Type
Distance Learning	See Selected Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	See Selected Course

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	0 h	0 h

Instructional Methods
See Selected Course

Study Format myStudies

Study Format	Course Type
myStudies	See Selected Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	See Selected Course

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
0 h	0 h	0 h	0 h	0 h	0 h

Instructional Methods

Foreign Language Italian

Module Code: DLFSWI_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Regina Cordes (Certificate Course Italian) / Prof. Dr. Regina Cordes (Foreign Language Italian)

Contributing Courses to Module

- Certificate Course Italian (DLFSWI01_E)
- Foreign Language Italian (DLFSI01_E)

Module Exam Type

Module Exam	Split Exam
	Certificate Course Italian • Study Format "myStudies": Participation Certificate (passed / not passed) • Study Format "Distance Learning": Participation Certificate (passed / not passed) Foreign Language Italian • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents
Certificate Course Italian To learn and deepen Italian as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language Italian** To learn and deepen Italian as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.

Learning Outcomes
Certificate Course Italian On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language Italian** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Certificate Course Italian

Course Code: DLFSWI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Italian as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)
    ▪ to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
▪ Grammar:
    ▪ Level A1 - present and past tenses, sentence structure, prepositions, etc.
    ▪ Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
    ▪ Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
    ▪ Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature
Compulsory Reading
Further Reading ▪ According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language Italian

Course Code: DLFSI01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Italian as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Italian according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature
Compulsory Reading
Further Reading ▪ According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format Distance Learning	**Course Type** Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language French

Module Code: DLFSWF_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Regina Cordes (Certificate Course French) / Prof. Dr. Regina Cordes (Foreign Language French)

Contributing Courses to Module
▪ Certificate Course French (DLFSWF01_E) ▪ Foreign Language French (DLFSF01_E)

Module Exam Type	
Module Exam	**Split Exam** Certificate Course French • Study Format "Distance Learning": Participation Certificate (passed / not passed) • Study Format "myStudies": Participation Certificate (passed / not passed) Foreign Language French • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes
Weight of Module see curriculum	

Module Contents	
Certificate Course French To learn and deepen French as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language French** To learn and deepen French as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.	
Learning Outcomes **Certificate Course French** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language French** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Languages	**Links to other Study Programs of the University** All Distance Learning Bachelor Programmes

Certificate Course French

Course Code: DLFSWF01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of French as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
    - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
    - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
    - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1) ▪ to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2) ▪ Grammar: ▪ Level A1 - present and past tenses, sentence structure, prepositions, etc. ▪ Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative) ▪ Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense ▪ Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature
Compulsory Reading
Further Reading ▪ According to the Information given in the Online Course speexx

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language French

Course Code: DLFSF01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of French as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language French according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature
Compulsory Reading
Further Reading ▪ According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language Spanish

Module Code: DLFSWS_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Regina Cordes (Certificate Course Spanish) / Prof. Dr. Regina Cordes (Foreign Language Spanish)

Contributing Courses to Module

- Certificate Course Spanish (DLFSWS01_E)
- Foreign Language Spanish (DLFSS01_E)

Module Exam Type

Module Exam	Split Exam
	Certificate Course Spanish • Study Format "Distance Learning": Participation Certificate (passed / not passed) • Study Format "myStudies": Participation Certificate (passed / not passed) Foreign Language Spanish • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents
Certificate Course Spanish To learn and deepen Spanish as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language Spanish** To learn and deepen Spanish as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.

Learning Outcomes
Certificate Course Spanish On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language Spanish** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Links to other Modules within the Study Program	Links to other Study Programs of the University
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Certificate Course Spanish

Course Code: DLFSWS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Spanish as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1) ▪ to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2) ▪ Grammar: ▪ Level A1 - present and past tenses, sentence structure, prepositions, etc. ▪ Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative) ▪ Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense ▪ Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature
Compulsory Reading
Further Reading ▪ According to the Information given in the Online Course speexx

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format myStudies

Study Format	Course Type
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language Spanish

Course Code: DLFSS01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of Spanish as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language Spanish according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

- to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature
Compulsory Reading
Further Reading ▪ According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language German

Module Code: DLFSWG

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Regina Cordes (Certificate Course German) / Prof. Dr. Regina Cordes (Foreign Language German)

Contributing Courses to Module

- Certificate Course German (DLFSWG01)
- Foreign Language German (DLFSG01)

Module Exam Type

Module Exam	Split Exam
	Certificate Course German • Study Format "myStudies": Participation Certificate (passed / not passed) • Study Format "Distance Learning": Participation Certificate (passed / not passed) Foreign Language German • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "myStudies": Exam, 90 Minutes

Weight of Module

see curriculum

Module Contents	
Certificate Course German To learn and deepen German as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material. **Foreign Language German** To learn and deepen German as a foreign language at the chosen CEFR level with regard to the respective qualitative aspects of range, correctness, fluency, interaction and coherence. The module includes a combination of listening, comprehension, writing and speaking exercises as well as various course material.	
Learning Outcomes **Certificate Course German** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures. **Foreign Language German** On successful completion, students will be able to ▪ meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR). ▪ use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Languages	**Links to other Study Programs of the University** All Distance Learning Bachelor Programmes

Certificate Course German

Course Code: DLFSWG01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of German as a foreign language is taught and practiced according to a CEFR placement test. Upon successful completion, students will receive a certificate corresponding to their chosen level.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply

and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)
  - to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
  - Level A1 - present and past tenses, sentence structure, prepositions, etc.
  - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
  - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
  - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format myStudies

Study Format	**Course Type**
myStudies	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Language Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Participation Certificate (passed / not passed)

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Foreign Language German

Course Code: DLFSG01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The qualification objectives correspond to levels A1, A2, B1 and B2 according to the criteria of the Common European Framework of Reference for Languages (CEFR). Using everyday subject areas, chosen areas of specialization, and using basic and advanced grammatical structures, the use of German as a foreign language is taught and practiced according to a CEFR placement test.

Course Outcomes

On successful completion, students will be able to

- meet the qualification objectives according to the chosen level (A1, A2, B1 or B2) according to the criteria of the Common European Framework of Reference for Languages (CEFR).
- use the foreign language German according to a CEFR placement test on the basis of everyday topics, selected areas of specialization and by adapting basic and advanced grammatical structures.

Contents

- Depending on the CEFR placement, students will be proficient
  - to understand and use familiar, everyday expressions and very simple phrases aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g. where they live, what kind of people they know or what kind of things they have - and they can give answers to questions of this kind. They can communicate in a simple way if the person they are talking to speaks slowly and clearly and is willing to help. (Level A1)
  - to understand sentences and frequently used expressions related to areas of immediate importance (e.g. personal and family information, shopping, work, local area). You can communicate in simple, routine situations involving a simple and direct exchange of information about familiar things. You can describe by simple means your own background and education, immediate environment and things related to immediate needs. (Level A2)
  - to understand the main points when clear standard language is used and when it's about familiar things from work, school, leisure, etc. You can handle most situations encountered while traveling in the language area. You can express yourself simply and coherently on familiar topics and personal areas of interest. You can talk about experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for plans and opinions. (Level B1)

    - to understand the main content of complex texts on concrete and abstract topics; and to understand specialist discussions in their own area of specialization. You can communicate so spontaneously and fluently that a normal conversation with native speakers is quite possible without major effort on either side. You can express yourself clearly and in detail on a wide range of topics, explain a point of view on a topical issue and state the advantages and disadvantages of various options. (Level B2)
- Grammar:
    - Level A1 - present and past tenses, sentence structure, prepositions, etc.
    - Level A2 - among other things tenses of the past, differences in the past tenses, imperative, subordinate clauses, pronouns (dative, accusative)
    - Level B1 - including introduction of past perfect, conjunctions, introduction of passive voice, adverbs, adjectives (difference), future tense
    - Level B2 - among others verb constructions, conditional clauses, indirect speech

Literature

Compulsory Reading

Further Reading

- According to the Information given in the Online Course speexx

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Study Format myStudies

Study Format	Course Type
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods
Instructional Methods are provided by the External Service Provider

Mastering Prompts

Module Code: DLBWMP_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Kristina Schaaff (Artificial Intelligence) / Prof. Dr. Knut Linke (Project: AI Excellence with Creative Prompting Techniques)

Contributing Courses to Module

- Artificial Intelligence (DLBDSEAIS01)
- Project: AI Excellence with Creative Prompting Techniques (DLBPKIEKPT01_E)

Module Exam Type

Module Exam	Split Exam
	<u>Artificial Intelligence</u> • Study Format "myStudies": Exam, 90 Minutes • Study Format "Distance Learning": Exam, 90 Minutes • Study Format "Duales myStudium": Exam, 90 Minutes <u>Project: AI Excellence with Creative Prompting Techniques</u> • Study Format "Duales myStudium": Oral Project Report • Study Format "Distance Learning": Oral Project Report

Weight of Module

see curriculum

Module Contents	
Artificial Intelligence **Project: AI Excellence with Creative Prompting Techniques**	
Learning Outcomes **Artificial Intelligence** On successful completion, students will be able to ▪ chart the historical developments in artificial intelligence. ▪ understand the approach of contemporary AI systems. ▪ comprehend the concepts behind reinforcement learning. ▪ analyze natural language using basic NLP techniques. ▪ scrutinize images and their contents. **Project: AI Excellence with Creative Prompting Techniques** On successful completion, students will be able to ▪ comprehend and apply basic prompting techniques in generative AI applications. ▪ analyze and evaluate the effectiveness of the basic prompts. ▪ apply ethical considerations to the design and use of AI for basic prompting techniques. ▪ design, implement, and refine effective prompts to real-world scenarios through hands-on exercises. ▪ showcase creative and innovative thinking in the application of prompting techniques to solve complex problems in their field of studies.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Data Science & Artificial Intelligence	**Links to other Study Programs of the University** All Bachelor Programs in the IT & Technology field

Artificial Intelligence

Course Code: DLBDSEAIS01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

The quest for artificial intelligence (AI) has captured humanity's interest for many decades and has been an active research area since the 1960s. This course will give a detailed overview of the historical developments, successes, and set-backs in AI, as well as modern approaches in the development of artificial intelligence.This course gives an introduction to reinforcement learning, a process similar to how humans and animals experience the world: exploring the environment and inferring the best course of action.This course also covers the principles of natural language processing and computer vision, both of which are key ingredients for an artificial intelligence to be able to interact with its environment.

Course Outcomes

On successful completion, students will be able to

- chart the historical developments in artificial intelligence.
- understand the approach of contemporary AI systems.
- comprehend the concepts behind reinforcement learning.
- analyze natural language using basic NLP techniques.
- scrutinize images and their contents.

Contents

1. History of AI
   1.1 Historical Developments
   1.2 AI Winter
   1.3 Expert Systems
   1.4 Notable Advances

2. Modern AI Systems
   2.1 Narrow versus General AI
   2.2 Application Areas

3. Reinforcement Learning
   3.1 What is Reinforcement Learning?
   3.2 Markov Chains and Value Function

Literature

Compulsory Reading

Further Reading

- Bear, F., Barry, W., & Paradiso, M. (2020). Neuroscience: Exploring the brain (4th ed.). Lippincott Williams & Wilkins.
- Chollet, F. (2018). Deep learning with Python. Manning.
- Geron, A. (2017). Hands-on machine learning with Scikit-Learn and TensorFlow. O’Reilly.
- Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems (2nd ed.). O’Reilly.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.
- Grus, J. (2019). Data science from scratch: First principles with Python. O’Reilly.
- Jurafsky, D., & Martin, J. H. (2022). Speech and language processing (3rd ed.). Prentice Hall.
- Russell, S. J., & Norvig, P. (2022). Artificial Intelligence: A modern approach (4th ed., global ed.). Pearson.
- Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). MIT Press. (Adaptive Computation and Machine Learning series).
- Szeliski, R. (2022). Computer vision: Algorithms and applications (2nd ed.). Springer. (Texts in Computer Science series).

Study Format myStudies

Study Format	**Course Type**
myStudies	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video	**Exam Preparation** ☑ Practice Exam ☑ Online Tests

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Course Book ☑ Video	☑ Practice Exam ☑ Online Tests

Project: AI Excellence with Creative Prompting Techniques

Course Code: DLBPKIEKPT01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description
In this course, students explore the fascinating world of prompting in generative AI applications. They engage in hands-on exercises to create new AI-generated content including text, images, and videos. Through these exercises, students learn how to effectively use, analyze, and evaluate these systems within their respective fields of study.

Course Outcomes

On successful completion, students will be able to

- comprehend and apply basic prompting techniques in generative AI applications.
- analyze and evaluate the effectiveness of the basic prompts.
- apply ethical considerations to the design and use of AI for basic prompting techniques.
- design, implement, and refine effective prompts to real-world scenarios through hands-on exercises.
- showcase creative and innovative thinking in the application of prompting techniques to solve complex problems in their field of studies.

Contents

- In this course, students work on a basic practical implementation of a generative AI use case by choosing from a selection provided in the complementary guideline. The course provides practical examples as learning materials and exercises with basic prompting techniques for open-source text, image, and video generation use cases. The exercises are designed to inspire and guide students in completing their own generative AI use case work, which includes a use case description, chosen prompting techniques, outcomes, and critical evaluations from both technical and ethical perspectives.

Literature
Compulsory Reading
Further Reading ▪ Dang, H., Mecke, L., Lehmann, F., Goller, S., & Buschek, D. (2022). How to prompt? Opportunities and challenges of zero- and few-shot learning for human-AI interaction in creative applications of generative models. arXiv. https://arxiv.org/pdf/2209.01390.pdf ▪ Eapen, T. T., Finkenstadt, D. J., Folk, J., & Venkataswamy, L. (2023). How generative AI can augment human creativity. Harvard Business Review, July–August, 56–64. ▪ Wei, J., Wang, X., Schuurmans, D., Bosma, M. Ichter, B., Xia, F., Chi, E. H., Le., Q. V., & Zhou, D. (2023). Chain-of-though prompting elicit reasoning in large language models. arXiv. https://arxiv.org/pdf/2201.11903.pdf

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Career Development

Module Code: DLBKAENT_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum		BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Heike Schiebeck (Personal Career Plan) / Prof. Dr. Heike Schiebeck (Personal Elevator Pitch)

Contributing Courses to Module
▪ Personal Career Plan (DLBKAENT01_E) ▪ Personal Elevator Pitch (DLBKAENT02_E)

Module Exam Type	
Module Exam	**Split Exam** <u>Personal Career Plan</u> • Study Format "Duales myStudium": Advanced Workbook • Study Format "Distance Learning": Advanced Workbook <u>Personal Elevator Pitch</u> • Study Format "Duales myStudium": Concept Presentation • Study Format "Distance Learning": Concept Presentation
Weight of Module see curriculum	

Module Contents

Personal Career Plan

- Career Theories and Models
- Career Development
- Choosing Possible Careers
- Personal Branding
- Career Strategy
- Global Careers
- Employment Search

Personal Elevator Pitch

Through the application of self-reflection, self-awareness based on relevant career success parameters students should develop career goals, career stages, and their career strategy. Taking into account their current professional and/or study situation, the central elements of a short-, and medium-term career planning are worked out by the students for their individual case. At the end of the course, students will be able to present their personal elevator pitch and communicate it in a proper way that is appropriate for the target group or audience. In this way, they will reflect on their current professional situation. The personal elevator pitch, being at hear of personal branding, supports the conveyance of this vision during personal networking activities.

Learning Outcomes	
Personal Career Plan On successful completion, students will be able to ▪ understand, apply, and reflect presented career theory and models with regard to their personal situation to arrive at a concept or pictore of a desired career. ▪ understand and critically reflect the concept of career and career planning. ▪ understand the relevance of a strategically oriented career planning. ▪ understand the importance of and conduct a personal assessment to identify one's personality, values, motivation, strengths, competencies, skills, and interests. ▪ understand the necessity of building and maintaining their own personal brand. ▪ understand differing job search processes across national/international contexts, and to create context-sensitive job applications accordingly. ▪ understand the principles of global careers and how to effectively act in international environments. **Personal Elevator Pitch** On successful completion, students will be able to ▪ identify their career goals, career stages, and the personal status quo with regard to their achievement. ▪ reflect their current situation and define where they want to aim. ▪ develop a career strategy by creating personal career goals and a coherent action plan. ▪ understand and apply the process of building a personal brand. ▪ define their identity, skills, profession, reasons to believe and necessary investments. ▪ identify their personal strengths and their core driver. ▪ understand the power of effective communication, networking, and storytelling. ▪ understand the principles and apply the process of designing a strong personal elevator pitch. ▪ critically reflect and adapt their personal elevator pitch to the specificities of the context, audience, target group, and way of delivery.	
Links to other Modules within the Study Program This module is similar to other modules in the field of Human Resources	**Links to other Study Programs of the University** All Bachelor Programs in the Human Resources field

Personal Career Plan

Course Code: DLBKAENT01_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	none

Course Description

In today's complex and ever-changing environment, the forms of careers vary depending on the context, understanding of values, and market dynamics. The 'classic career ladder' that one is climbing being the only predominant form of career is long outdated, and individuals are being confronted with a great number of opportunities regarding industry or job choice and working arrangements.Considering the great variety of options especially for well-educated individuals, has become more important than ever to make informed decisions. This course is designed to support students maneauvering themselves through these complexities of their personal career plan, whereby self-awareness, self-reflection, and goal-setting are important elements of this process. Guided by central elements of career theory, career models, and research outcomes, students will be given tools and reflection exercises to arrive at a solid, directly applicable strategy to further steet their professional progress and career steps.

Course Outcomes

On successful completion, students will be able to

- understand, apply, and reflect presented career theory and models with regard to their personal situation to arrive at a concept or pictore of a desired career.
- understand and critically reflect the concept of career and career planning.
- understand the relevance of a strategically oriented career planning.
- understand the importance of and conduct a personal assessment to identify one's personality, values, motivation, strengths, competencies, skills, and interests.
- understand the necessity of building and maintaining their own personal brand.
- understand differing job search processes across national/international contexts, and to create context-sensitive job applications accordingly.
- understand the principles of global careers and how to effectively act in international environments.

Contents

1. Career Theories and Approaches
   - 1.1 Traditional Career Theories and Models
   - 1.2 Protean Career Orientation
   - 1.3 Career Learning Cycle

2. Career Development

Literature
Compulsory Reading
Further Reading ▪ Baruch, Y. (2022). Managing Careers and Employability. SAGE. ▪ Greenhaus, J.H., Callanan, G.A., & Godshalk, V.M. (2018). Career Management for Life (5th edition). College of Business & Public Management Faculty Books. ▪ Hoeckstra, H. (2011). A career roles model of career development. Journal of Vocational Behavior, 78(2), 159-173. ▪ Ibarra, H. (2004). Working Identity: Unconventional Strategies for Reinventing Your Career. Harvard Business School Press. ▪ Kingsley, T. (2022). Personal Branding. Independently published. ▪ Ng, T.W.H., Eby, L.T., Sorensen, K.L., & Feldman, D.C. (2005). Predictors of objective and subjective career success: A meta-analysis. Personnel psychology, 58(2), 367-408. ▪ Ng, T.W.H., & Feldman, D.C. (2014). Subjective career success: A meta-analytic review. Journal of Vocational Behavior, 85(2), 169-179.

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Advanced Workbook

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Course Book ☑ Video	**Exam Preparation** ☑ Online Tests ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Theory Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** yes
Type of Exam	Advanced Workbook

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Course Feed	☑ Course Book	☑ Online Tests
☑ Intensive Live Sessions/Learning Sprint	☑ Video	☑ Guideline
☑ Recorded Live Sessions		

Personal Elevator Pitch

Course Code: DLBKAENT02_E

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		5	DLBKAENT01_E

Course Description

The forms of careers vary depending on the context or personal preferences in today's ever-changing, demanding, and complex environment. Changes in the environment, as for example technology, sustainability, and the rise of artificial intelligence, push individuals to take career transitions into their own hands. Personal endeavors to develop one's career through the acquisition of, for instance, new projects, jobs, or employers, require the right strategies to be successful. Contacts through targeted networking and the development of one's own brand play a special role here. Evenly so for individuals starting their careers after having accomplished their education, effective networking is key to career entry and development in these turbulent times. In addition, personal branding is a concept that not only has gained relevance in research but is also widely used in career counseling. Developing and conveying a personal brand is central to this course. Using the personal branding approach during networking activities, individuals can actively contribute to their career success.

Course Outcomes

On successful completion, students will be able to

- identify their career goals, career stages, and the personal status quo with regard to their achievement.
- reflect their current situation and define where they want to aim.
- develop a career strategy by creating personal career goals and a coherent action plan.
- understand and apply the process of building a personal brand.
- define their identity, skills, profession, reasons to believe and necessary investments.
- identify their personal strengths and their core driver.
- understand the power of effective communication, networking, and storytelling.
- understand the principles and apply the process of designing a strong personal elevator pitch.
- critically reflect and adapt their personal elevator pitch to the specificities of the context, audience, target group, and way of delivery.

Contents

- The core element of this course is a personal elevator pitch with the use of a personal branding canvas. The creation of a personal brand is not only relevant for self-employed freelancers or entrepreneurs but is as well helpful for individuals who strive for their own further development on the career ladder within their organization or for those who are seeking employment. Having understood the characteristics of and reasoning behind personal branding and the underlying process, students will be able to apply this process to their own person and situation.

- Self-awareness being the main 'ingredient' for an effective personal brand, students will be encouraged to go on an intensive self-reflection journey to deepen their understanding of their identity, skills, profession, and reasons to believe for a personal brand, and subsequently, for a personal elevator pitch.
- Being at the heart of and the essence of personal branding, the elevator pitch enables individuals to impactfully present themselves in a nutshell to important individuals and potential employers. Having understood the principles and key success factors characterizing an elevator pitch, students will be able to develop their own one. They will learn to consider aspects like timing, benefit, clear positioning, target audience through an oral form of delivery. In addition, the role of communication, networking and storytelling principles will be highlighted.
- Knowledge of the core elements and success factors of the personal elevator pitch within the framework of the individual career development.

Literature

Compulsory Reading

Further Reading

- Dowling, D. (2009). How to Perfect an Elevator Pitch About Yourself. Harvard Business Review. https://hbr.org/2009/05/how-to-perfect-an-elevator-pit.
- Gorbatov, S., Khapova, S.N., & Lysova, E.I. (2018). Personal branding: Interdisciplinary systematic review and research agenda. Frontiers in psychology, 2238.
- Gorbatov, S., Khapova, S.N., & Lysova, E.I. (2019). Get noticed to get ahead: The impact of personal branding on career success. Frontiers in psychology, 2662.
- Jourdan Jr., Louis F., Deis, M., & Lysova, E.I. (2010). Getting Your Elevator Pitch To The Plate. Business Journal for Entrepreneurs, 2010(1), 43-47.
- Woodside, A.G. (2010). Brand consumer storytelling theory and research: Introduction to a Psychology & Marketing special issue. Psychology & Marketing, 27(6), 531-540.

Study Format Duales myStudium

Study Format	Course Type
Duales myStudium	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Concept Presentation

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Concept Presentation

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
Tutorial Support ☑ Course Feed ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Exam Preparation** ☑ Guideline

Bachelor Thesis

Module Code: DLBBT

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction and Examination
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Degree Program Advisor (SGL) (Bachelor Thesis) / Degree Program Advisor (SGL) (Colloquium)

Contributing Courses to Module

- Bachelor Thesis (DLBBT01)
- Colloquium (DLBBT02)

Module Exam Type

Module Exam	Split Exam
	Bachelor Thesis • Study Format "myStudies": Bachelor Thesis • Study Format "Distance Learning": Bachelor Thesis Colloquium • Study Format "myStudies": Colloquium • Study Format "Distance Learning": Colloquium

Weight of Module

see curriculum

Module Contents
Bachelor Thesis ▪ Bachelor's thesis ▪ Colloquium on the bachelor's thesis **Colloquium**

Learning Outcomes
Bachelor Thesis On successful completion, students will be able to ▪ work on a problem from their major field of study by applying the specialist and methodological skills they have acquired during their studies. ▪ independently analyze selected tasks with scientific methods, critically evaluate them, and develop appropriate solutions under the guidance of an academic supervisor. ▪ record and analyze existing (research) literature appropriate to the topic of their bachelor's thesis. ▪ prepare a detailed written elaboration in compliance with scientific methods. **Colloquium** On successful completion, students will be able to ▪ present a problem from their field of study using academic presentation and communication techniques. ▪ reflect on the scientific and methodological approach chosen in their bachelor's thesis. ▪ demonstrate that they can actively answer subject-related questions from the subject experts (reviewers of the bachelor’s thesis).

Links to other Modules within the Study Program	Links to other Study Programs of the University
All modules in the Bachelor program	All Bachelor programs in distance learning

Bachelor Thesis

Course Code: DLBBT01

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		9	none

Course Description

The aim and purpose of the bachelor's thesis is to successfully apply the subject-specific and methodological competencies acquired during the course of study in the form of an academic dissertation with a thematic reference to the major field of study. The content of the bachelor's thesis can be a practical-empirical or theoretical-scientific problem. Students should prove that they can independently analyze a selected problem with scientific methods, critically evaluate it, and work out proposed solutions under the subject-methodological guidance of an academic supervisor. The topic chosen by the student from their respective field of study should meet the acquired scientific competences, deepening their academic knowledge and skills in order to meet the future needs of the field.

Course Outcomes

On successful completion, students will be able to

- work on a problem from their major field of study by applying the specialist and methodological skills they have acquired during their studies.
- independently analyze selected tasks with scientific methods, critically evaluate them, and develop appropriate solutions under the guidance of an academic supervisor.
- record and analyze existing (research) literature appropriate to the topic of their bachelor's thesis.
- prepare a detailed written elaboration in compliance with scientific methods.

Contents

- The bachelor's thesis must be written on a topic that relates to the content of the respective major field of study. In the context of the bachelor's thesis, the problem, as well as the scientific research goal, must be clearly emphasized. The work must reflect the current state of knowledge of the topic to be examined by means of an appropriate literature analysis. The student must prove their ability to use the acquired knowledge theoretically and/or empirically in the form of an independent and problem-solution-oriented application.

Literature
Compulsory Reading
Further Reading ▪ Lipson, C. (2018). How to write a BA thesis. A practical guide from your first ideas to your finished paper (2nd ed.). University of Chicago Press. ▪ Turabian, K. L. (2013). A Manual for Writers of Research Papers, theses, and dissertations (8th ed.). University of Chicago Press. ▪ Selection of literature according to topic

Study Format myStudies

Study Format	Course Type
myStudies	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Bachelor Thesis

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
270 h	0 h	0 h	0 h	0 h	270 h

Instructional Methods		
Tutorial Support	**Learning Material**	**Exam Preparation**
☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	☑ Slides	☑ Review Book

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Bachelor Thesis

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
270 h	0 h	0 h	0 h	0 h	270 h

Instructional Methods		
Tutorial Support ☑ Intensive Live Ses-sions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides	**Exam Preparation** ☑ Review Book

Colloquium

Course Code: DLBBT02

Study Level	Language of Instruction and Examination	Contact Hours	CP	Admission Requirements
BA	English		1	none

Course Description

The colloquium will take place after the submission of the bachelor’s thesis. This is done at the invitation of the experts. During the colloquium, students must prove that they have independently produced the content and results of the written work. The content of the colloquium is a presentation of the most important work contents and research results by the student as well as the answering of questions by experts.

Course Outcomes

On successful completion, students will be able to

- present a problem from their field of study using academic presentation and communication techniques.
- reflect on the scientific and methodological approach chosen in their bachelor's thesis.
- demonstrate that they can actively answer subject-related questions from the subject experts (reviewers of the bachelor’s thesis).

Contents

- The colloquium includes a presentation of the most important results of the bachelor's thesis, followed by the student answering the reviewers' technical questions.

Literature

Compulsory Reading

Further Reading

- Subject specific literature chosen by the student

Study Format myStudies

Study Format	Course Type
myStudies	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Colloquium

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
30 h	0 h	0 h	0 h	0 h	30 h

Instructional Methods	
Tutorial Support ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Course

Information about the examination	
Examination Admission Requirements	**Online Tests:** no
Type of Exam	Colloquium

Student Workload					
Self Study	**Contact Hours**	**Tutorial/Tutorial Support**	**Self Test**	**Independent Study**	**Hours Total**
30 h	0 h	0 h	0 h	0 h	30 h

Instructional Methods	
Tutorial Support ☑ Intensive Live Sessions/Learning Sprint ☑ Recorded Live Sessions	**Learning Material** ☑ Slides