MODULE HANDBOOK

Bachelor of Engineering

Bachelor Robotics (FS-BAROE)

180 ECTS

Distance Learning

INTERNATIONAL
UNIVERSITY OF
APPLIED SCIENCES

Classification: Undergraduate

Contents

2021-03-01

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
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 <u>Study Format: Distance Learning</u> Exam or Written Assessment: Written Assignment, 90 Minutes	**Split Exam**
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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Introduction to Robotics

Course Code: DLBROIR01_E

Study Level	Language of Instruction	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

Literature
Compulsory Reading
Further Reading ▪ Ben-Ari, M./Mondada, F. (2017): Elements of Robotics. Springer International Publishing, Basel. ▪ Brooks, R. A. (2003): Flesh and machines: how robots will change us. Vintage Books, New York, NY. ▪ Gupta, A. K./Arora, S. K./Westcott, J. R. (2016): Industrial automation and robotics. Mercury Learning & Information. ▪ Lynch, K. M./Park, F. C. (2017): Modern robotics: mechanics, planning, and control. Cambridge University Press, Cambridge. ▪ Mihelj, M. et al (2018): Robotics. 2nd edition, Springer International Publishing, Basel. ▪ Siciliano, B./Khatib, O. (Eds.). (2016): Springer Handbook of Robotics. Springer International Publishing, Basel. ▪ Siegwart, R./Nourbakhsh, I. R./Scaramuzza, D. (2011): Introduction to Autonomous Mobile Robots. The MIT Press, Cambridge, MA.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam or Written Assessment: Written Assignment, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
100 h	0 h	25 h	25 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☑ Live Tutorium/Course Feed

Introduction to Academic Work

Module Code: DLBCSIAW

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

Semester / Term	Duration	Regularly offered in	
s. Curriculum/see curriculum	Minimum 1 semester	WiSe/SoSe	

Module Coordinator

Prof. Dr. Maya Stagge (Introduction to Academic Work)

Contributing Courses to Module

- Introduction to Academic Work (DLBCSIAW01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Workbook	

Weight of Module

s. Curriculum/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 IUBH

Learning Outcomes	
Introduction to Academic Work Nach erfolgreichem Abschluss sind die Studierenden in der Lage,/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 IUBH.	
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 IUBH** All Bachelor Programmes in the Business & Management field

Introduction to Academic Work

Course Code: DLBCSIAW01

Study Level	Language of Instruction	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 IUBH examination forms and insight into their requirements and implementation.

Course Outcomes

Nach erfolgreichem Abschluss sind die Studierenden in der Lage,/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 IUBH.

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
   - 2.3 Data Protection and Affidavit
   - 2.4 Orthography and Shape
   - 2.5 Identification and Delimitation of Topics
   - 2.6 Research Questions and Structure
3. Research Methods
   - 3.1 Empirical Research
   - 3.2 Literature and Reviews
   - 3.3 Quantitative Data Collection
   - 3.4 Qualitative Data Collection
   - 3.5 Mix of Methods
   - 3.6 Critique of Methods and Self-Reflection
4. Librarianship: Structure, Use, and Literature Management
   - 4.1 Plagiarism Prevention
   - 4.2 Database Research
   - 4.3 Literature Administration
   - 4.4 4.4 Citation and Author Guidelines
   - 4.5 4.5 Bibliography
5. Scientific Work at the IUBH – Research Essay
6. Scientific Work at the IUBH - Project Report
7. Scientific Work at the IUBH - Case Study
8. Scientific Work at the IUBH - Bachelor Thesis
9. Scientific Work at the IUBH – Oral Assignment
10. Scientific Work at the IUBH – Oral Project Report
11. Scientific Work at the IUBH - Colloquium
12. Scientific Work at the IUBH - Portfolio
13. Scientific Work at the IUBH - Exam

Literature
Compulsory Reading
Further Reading ▪ Bortz, J./Döring, N. (2012): Forschungsmethoden und Evaluation. Für Human- und Sozialwissenschaftler. 5. Auflage, Springer Medizin Verlag, Heidelberg. ▪ Braunecker, C. (2016): How to do Empirie, how to do SPSS – eine Gebrauchsanleitung. Facultas Verlags- und Buchhandels AG, Wien. ▪ Engelen, E.M. et al. (2010): Heureka – Evidenzkriterien in den Wissenschaften, ein Kompendium für den interdisziplinären Gebrauch. Spektrum akademischer Verlag, Heidelberg. ▪ Flick, U. et al. (2012): Handbuch Qualitative Sozialforschung. Grundlagen, Konzepte, Methoden und Anwendungen. 3. Auflage, Beltz Verlag, Weinheim. ▪ Hug, T./Poscheschnik, G. (2015): Empirisch Forschen, 2. Auflage, Verlag Huter & Roth KG, Wien. ▪ Hussy, W. et al. (2013): Forschungsmethoden in Psychologie und Sozialwissenschaften. 2. Auflage, Springer Medizin Verlag, Heidelberg.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Workbook

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☑ Guideline
☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☐ Exam Template	

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Leonardo Riccardi (Mathematics II)

Contributing Courses to Module

- Mathematics II (DLBCSM201)

Module Exam Type

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

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(s) of Methods.	**Links to other Study Programs of IUBH** All Bachelor Programmes in the Business & Management field(s).

Mathematics II

Course Code: DLBCSM201

Study Level	Language of Instruction	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
   - 4.3 Adjacency Matrix

5. The Problem of the Shortest Routes
    - 5.1 Directional Graph or Digraph
    - 5.2 Weighted Graph
    - 5.3 Dijkstra's Algorithm

6. The Königsberg Bridge Problem
    - 6.1 Routing in Graphs
    - 6.2 Eulerian Graph
    - 6.3 Hierholzer's Algorithm
    - 6.4 The Postman Problem

7. A City Tour Where Each City is Visited Exactly Once.
    - 7.1 Special Graphs
    - 7.2 Hamiltonian Graph
    - 7.3 The Ore and Dirac Condition
    - 7.4 The Problem of the Traveling Salesman

8. Trees
    - 8.1 Properties of Trees
    - 8.2 Root Tree
    - 8.3 Spanning Tree
    - 8.4 Minimal Spanning Tree

Literature

Compulsory Reading

Further Reading

- Hartmann, P. (2014): Mathematik für Informatiker. Ein praxisbezogenes Lehrbuch. 6. Auflage, Springer Vieweg, Wiesbaden.
- Hoffmann, U. (2005): Mathematik für Wirtschaftsinformatiker. Übungen mit Lösungen. (URL: http://opus.uni-lueneburg.de/opus/volltexte/2006/383/pdf/Uebungen_zur_Mathematik_fuer_Wirtschaftsinformatiker.pdf [letzter Zugriff: 27.02.2017]).
- Nitzsche, M. (2009): Graphen für Einsteiger. Rund um das Haus vom Nikolaus. 3. Auflage. Vieweg +Teubner, Wiesbaden.
- Teschl, G./Teschl, S. (2013): Diskrete Mathematik und lineare Algebra. 4. Auflage, Springer Vieweg, Berlin, Heidelberg.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

Scientific and technical fundamentals

Module Code: DLBINGNAG_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Moritz Venschott (Scientific and technical fundamentals)

Contributing Courses to Module
▪ Scientific and technical fundamentals (DLBINGNAG01_E)

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

Module Contents
▪ Part 1: Introduction ▪ Overview ▪ Mathematical principles ▪ Part 2: Physics ▪ Thermodynamics ▪ Electricity and magnetism ▪ Part 3: Materials science ▪ Solid-State Physics ▪ Materials ▪ Part 4: Engineering Mechanics ▪ Statics ▪ Dynamics ▪ Strength of Materials

Learning Outcomes
Scientific and technical fundamentals On successful completion, students will be able to ▪ identify basic methods and subject areas in natural sciences. ▪ know mathematical basics for utilisation in physics. ▪ identify the basics of thermodynamics, electricity and magnetism. ▪ identify the physical properties of solids. ▪ distinguish solids with their bonding and conductivity types and differentiate materials with regard to their properties. ▪ identify basic tasks of statics and apply them. ▪ recognize the laws of dynamics and apply them. ▪ identify different stress types and calculate them.

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

Scientific and technical fundamentals

Course Code: DLBINGNAG01_E

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

Course Description

The aim of the course is to give students an overview of essentials in natural sciences relevant to Engineering Studies. For this purpose, selected areas of physics, materials science and technical mechanics are considered.In the first part, this course introduces elementary scientific principles and incorporates mathematical basics. In the second part, thermodynamics, electricity and magnetism are used to give an overview of selected areas of physics. The third part deals with physical properties of solids and how they are used in Materials Science. The course concludes with a fourth topic, which deals with selected aspects of Technical Mechanics.

Course Outcomes

On successful completion, students will be able to

- identify basic methods and subject areas in natural sciences.
- know mathematical basics for utilisation in physics.
- identify the basics of thermodynamics, electricity and magnetism.
- identify the physical properties of solids.
- distinguish solids with their bonding and conductivity types and differentiate materials with regard to their properties.
- identify basic tasks of statics and apply them.
- recognize the laws of dynamics and apply them.
- identify different stress types and calculate them.

Contents

1. Introduction to methods and disciplines
   - 1.1 Scientific method
   - 1.2 Disciplines
   - 1.3 Key ares and quantities of physics
   - 1.4 Description of chemical structures

2. Mathematical principles
   - 2.1 Complex numbers
   - 2.2 Differential calculus
   - 2.3 Integral Calculus

3. Thermodynamics
    - 3.1 Basics
    - 3.2 Fundamental principles
    - 3.3 Change of state theory
4. Electricity and magnetism
    - 4.1 Definitions and laws
    - 4.2 Transfer of charges
    - 4.3 Fields
5. Solid-State Physics
    - 5.1 Atomic and quantum physics basics
    - 5.2 Binding types of solids
    - 5.3 Crystalline, amorphous and macromolecular solids
    - 5.4 Conductors, semiconductors and insulators
    - 5.5 Superconductor
6. Materials Science
    - 6.1 Properties of materials
    - 6.2 Metallic materials
    - 6.3 Plastics
    - 6.4 Ceramic materials
    - 6.5 Composite materials
7. Statics
    - 7.1 Basics
    - 7.2 Fundamental tasks
    - 7.3 Trusses
8. Dynamics
    - 8.1 Movement theory
    - 8.2 Rotational movements
    - 8.3 Work and performance
9. Theory of Strength of Materials
    - 9.1 Basic terms
    - 9.2 Stress types
    - 9.3 Surface pressure and moments in metric space

Literature
Compulsory Reading
Further Reading ▪ Arnold, B. (2013): Werkstofftechnik für Wirtschaftsingenieure. Springer, Berlin/Heidelberg. ▪ Böge, A/Böge, W. (2015): Technische Mechanik. Statik – Reibung – Dynamik – Festigkeitslehre – Fluidmechanik. 31. Auflage, Springer Vieweg, Berlin/Heidelberg. ▪ Eichler, J. (2011): Physik für das Ingenieurstudium. 4. Auflage, Vieweg+Teubner, Wiesbaden. ▪ Hering, E./Martin, R./Stohrer, M. (Hrsg.) (2012): Physik für Ingenieure. 11. Auflage, Springer, Berlin/Heidelberg. ▪ Kittel, C. (2013): Einführung in die Festkörperphysik. 15. Auflage, Oldenbourg, München. ▪ Knight, R. W. (2013): Physics for Scientists and Engineers. A Strategic Approach. 3. Auflage, Pearson, Boston. ▪ Otto, M. (2011): Rechenmethoden für Studierende der Physik im ersten Jahr. Spektrum, Heidelberg.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☑ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Moustafa Nawito (Mathematics: Linear Algebra)

Contributing Courses to Module

- Mathematics: Linear Algebra (DLBDSMFLA01)

Module Exam Type

Module Exam	Split Exam
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

<table>
<tr><td colspan="2">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.</td></tr>
<tr><td>Links to other Modules within the Study Program

This module is similar to other modules in the field of Methods</td><td>Links to other Study Programs of IUBH

All Bachelor Programmes in the IT & Technology fields</td></tr>
</table>

Mathematics: Linear Algebra

Course Code: DLBDSMFLA01

Study Level	Language of Instruction	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. Fundamentals
   - 1.1 Systems of linear equations
   - 1.2 Matrices as compact representations of linear equations
   - 1.3 Matrix algebra
   - 1.4 Inverse and trace
2. Vector Spaces
   - 2.1 Definition
   - 2.2 Linear combination and linear dependance
   - 2.3 Base, span, and rank
3. Linear and affine mappings
   - 3.1 Matrix representations of linear mappings
   - 3.2 Image and kernel
   - 3.3 Affine spaces and sub-spaces
   - 3.4 Affine mappings

4. Analytical Geometry
   - 4.1 Norms
   - 4.2 Inner and dot product
   - 4.3 Orthogonal projections
   - 4.4 Rotations

5. Matrix Decomposition
   - 5.1 Determinant and trace
   - 5.2 Eigenvalues and eigenvectors
   - 5.3 Cholesky decomposition
   - 5.4 Eigenvalue decomposition and diagonalisation
   - 5.5 Singular value decomposition

Literature

Compulsory Reading

Further Reading

- Arfken, G./Weber, H. J./Harris, F. E. (2012): Mathematical methods for physicists. 7th ed., Academic Press, Cambridge, MA.
- Boas, M. L. (2006): Mathematical methods in the physical sciences. 3rd ed.,Wiley, Hoboken, NJ.
- Deisenroth, M. P./Faisal, A./Ong C. S. (2019): Math for machine learning. (URL: https://mml-book.com).
- Riley, K. F./Hobson, M. P./Bence, S. J. (2006): Mathematical methods for physics and engineering. Cambridge University Press, Cambridge.
- Strang, G. (2016): Introduction to linear algebra, 5th ed., Wellesley-Cambridge Press, Wellesley, MA.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☑ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Leonardo Riccardi (Technical Drawing)

Contributing Courses to Module

- Technical Drawing (DLBROTD01_E)

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

Module Contents

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

<table>
<tr><td colspan="2">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.</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 IUBH
All Bachelor Programmes in the IT & Technology fields</td></tr>
</table>

Technical Drawing

Course Code: DLBROTD01_E

Study Level	Language of Instruction	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
   - 4.1 Line Types
   - 4.2 Dimensioning Rules

5. Surfaces
   - 5.1 Definition
   - 5.2 Illustration

6. Tolerances
   - 6.1 Dimensioning
   - 6.2 Standardized Fitting System
   - 6.3 Basic Shaft/Basic Hole
   - 6.4 Calculation of Tolerance Chains

7. Standards
   - 7.1 Classification of Standards
   - 7.2 Technical Drawing Standards
   - 7.3 Standard Parts

Literature

Compulsory Reading

Further Reading

- Gomeringer, R. et al. (2019): Tabellenbuch Metall. Mit Formelsammlung. 48. Auflage, Verlag Europa-Lehrmittel, Haan-Gruiten.
- Hoischen, H./Fritz, A (2018): Technisches Zeichnen. 36. Auflage, Cornelsen, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
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☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

DLBROTD01_E

2. Semester

Production Engineering

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Mario Boßlau (Production Engineering)

Contributing Courses to Module

- Production Engineering (DLBDSEAR01)

Module Exam Type

Module Exam	Split Exam
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

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Learning Outcomes

Production Engineering

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.

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Links to other Modules within the Study Program

This module is similar to other modules in the fields of Computer Science & Software Development

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Links to other Study Programs of IUBH

All Bachelor Programs in the IT & Technology fields

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Production Engineering

Course Code: DLBDSEAR01

Study Level	Language of Instruction	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. Main Production Groups According to DIN 8580
   - 2.1 Archetypes
   - 2.2 Reshaping
   - 2.3 Cutting (Cutting, Machining, Ablation)
   - 2.4 Joining
   - 2.5 Coating
   - 2.6 Substance Property Changes

3. Additive Manufacturing Processes
   - 3.1 Basic Principles and Legal Aspects
   - 3.2 Stereolithography (STL)
   - 3.3 Selective Laser Sintering and Selective Beam Melting With Laser or Electron Beam
   - 3.4 Fused Deposition Modeling (FDM)
   - 3.5 Multi-Jet Modeling (MJM) and Poly-Jet Process (PJM)
   - 3.6 3D Printing Process (3DP)
   - 3.7 Laminating Processes
   - 3.8 Mask Sintering

4. Rapid Prototyping
   - 4.1 Definition
   - 4.2 Strategic and Operational Aspects
   - 4.3 Application Areas and Examples

5. Rapid Tooling
   - 5.1 Definition, Strategic, and Operational Aspects
   - 5.2 Indirect and Direct Procedures

6. Direct/Rapid Manufacturing
   - 6.1 Potentials and Requirements for Procedures
   - 6.2 Implementation, Application Areas, and Examples

7. Cyber-Physical Production Plants
   - 7.1 Derivation of the Terms Industry 4.0 and Cyber-Physical Systems
   - 7.2 Megatrend Cyber Physical Systems (CPS)
   - 7.3 Definition Cyber-Physical Production Plant
   - 7.4 Effects on Planning and Operation of Production Facilities
   - 7.5 Dynamic Reconfiguration and Migration of Production Facilities

Literature
Compulsory Reading
Further Reading ▪ Anderson, C. (2012): Makers. The new industrial revolution. Crown Business, New York. ▪ Bauernhansl, Thomas/Hompel, M. ten/Vogel-Heuser, B. (Hrsg.) (2014): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung – Technologien – Migration. Springer, Wiesbaden. ▪ Gebhardt, A. (2012): Understanding Additive Manufacturing. Rapid Prototyping – Rapid Tooling – Rapid Manufacturing. Hanser, München/Cincinnati. ▪ Lachmayer, R./Lippert, R. B./Fahlbusch, T. (Hrsg.) (2016): 3D-Druck beleuchtet. Additive Manufacturing auf dem Weg in die Anwendung. Springer, Berlin/Heidelberg. ▪ Wittenstein, M. et al. (Hrsg.) (2015): Intelligente Vernetzung in der Fabrik. Industrie 4.0. Umsetzungsbeispiele für die Praxis. Fraunhofer Verlag, Stuttgart.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Dr. Reza Shahbazfar (Introduction to Programming with Python)

Contributing Courses to Module

- Introduction to Programming with Python (DLBDSIPWP01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
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 This module is similar to other modules in the field(s) of Data Science & Artificial Intelligence.	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology field(s).

Introduction to Programming with Python

Course Code: DLBDSIPWP01

Study Level	Language of Instruction	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. 2nd ed., O'Reilly, Sebastopol, CA.
- Lubanovic, B. (2019): Introducing Python. 2nd ed., O'Reilly, Sebastopol, CA.
- Lutz, M. (2013): Learning Python. 5th ed., O'Reilly, Sebastopol, CA.
- Matthes, E. (2019): Python crash course: A hands-on, project-based introduction to programming. 2nd ed., No Starch Press, San Francisco, CA.
- Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly, Sebastopol, CA.

Study Format Distance Learning

Study Format Distance Learning	**Course Type** Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study 90 h	**Presence** 0 h	**Tutorial** 30 h	**Self Test** 30 h	**Practical Experience** 0 h	**Hours Total** 150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Timo Heinisch (Mathematics: Analysis)

Contributing Courses to Module
▪ Mathematics: Analysis (DLBDSMFC01)

Module Exam Type	
Module Exam 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 IUBH** All Bachelor Programmes in the IT & Technology fields

Mathematics: Analysis

Course Code: DLBDSMFC01

Study Level	Language of Instruction	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

- Arens, T. et al. (2013): Basic knowledge of mathematics studies. Analysis and Linear Algebra with Cross Connections. Springer, Berlin/Heidelberg.
- Boas, M. L. (2006): Mathematical methods in the physical sciences. Third edition. Wiley. Hoboken, NJ.
- Deisenroth, M. P./Faisal, A./Ong C.-S.: Math for ML. Cambridge University Press.
- Heuser, H. (2009): Textbook of Analysis. Vieweg + Teubner (studies). Wiesbaden.
- Modler, F./Kreh, M. (2014): Tutorial Analysis 1 and Linear Algebra 1. Mathematics explained and commented by students for students. 3rd edition, Springer Spektrum, Berlin/Heidelberg.
- Papula, L. (2014): Mathematics for engineers and scientists. Vol. 1: A textbook and workbook for basic studies. Springer Vieweg, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☑ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Leonardo Riccardi (Mechanics - Statics)

Contributing Courses to Module
▪ Mechanics - Statics (DLBROMS01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programs in the IT & Technology fields

Mechanics - Statics

Course Code: DLBROMS01_E

Study Level	Language of Instruction	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. Physical Quantities in Statics
   - 1.1 Newton's Axioms
   - 1.2 Force, Moment and Equilibrium of Forces
   - 1.3 External and Internal Forces
   - 1.4 Composition and Decomposition of Forces

2. Basics of Statics
   - 2.1 General Conditions of Equilibrium
   - 2.2 Static Determination
   - 2.3 Bearing Types (Monovalent, Bivalent and Trivalent Bearings)
   - 2.4 Bearing Reactions
   - 2.5 Determination of Bearing Reactions

3. Balance of Planar Force Systems
   - 3.1 Equilibrium Conditions
   - 3.2 Statically Determined Bearing Reactions

4. Internal Force Variables
   - 4.1 Definition and Calculation Of Internal Force Variables
   - 4.2 Common Carrier Types
   - 4.3 Center Of Gravity/Center Of Area/Center Of Line

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

Literature

Compulsory Reading

Further Reading

- Assmann, B./Selke, P. (2009): Technische Mechanik 1. Statik. 19. Auflage, Oldenbourg Verlag, München.
- Gross, D. et al. (2019): Technische Mechanik 1. Statik. Springer Vieweg Verlag, Wiesbaden.
- Holzmann G./Meyer, H./Schumpich, G. (2009): Technische Mechanik. Statik. 12. Auflage, Vieweg +Teubner Verlag, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☑ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

DLBROMS01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Moustafa Nawito (Electrical Engineering)

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

Module Exam Type	
Module Exam 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 IUBH** All Bachelor Programmes in the IT & Technology fields

Electrical Engineering

Course Code: DLBINGET01-01_E

Study Level	Language of Instruction	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 ▪ Hagmann, G. (2013): Grundlagen der Elektrotechnik. 16. Auflage, AULA-Verlag, Wiebelsheim. ▪ Scherz, P. (2016): Practical Electronics for Inventors. 4. Auflage, Mcgraw-Hill Education, New York. ▪ Weißgerber, W. (2015): Elektrotechnik für Ingenieure 1. 10. Auflage, Springer, Wiesbaden. ▪ Weißgerber, W. (2015): Elektrotechnik für Ingenieure 2. 9. Auflage, Springer, Wiesbaden. ▪ Weißgerber, W. (2015): Elektrotechnik für Ingenieure 3. 9. Auflage, Springer, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☑ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

Prof. Dr. Leonardo Riccardi (Project: Design with CAD)

Contributing Courses to Module

- Project: Design with CAD (DLBROPDCAD01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Fernstudium Oral Project Report	

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. ▪ construct and design components. ▪ create assemblies. ▪ review assembly and functionality (Digital Twin).	
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 IUBH** All Bachelor Programs in the IT & Technology fields

Project: Design with CAD

Course Code: DLBROPDCAD01_E

Study Level	Language of Instruction	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.
- construct and 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 construction design. For this purpose, students will use these common methods of construction.
    - 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 Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

DLBROPDCAD01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Leonardo Riccardi (Sensor Technology)

Contributing Courses to Module
▪ Sensor Technology (DLBROST01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning 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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Sensor Technology

Course Code: DLBROST01_E

Study Level	Language of Instruction	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

9. Advanced Sensor Technology
   - 9.1 Organic Sensors
   - 9.2 Sensors for Health and Environment
   - 9.3 Wearable Sensors
   - 9.4 Wireless Sensors in Industrial Environments

Literature

Compulsory Reading

Further Reading

- Kalantar-Zadeh, K. (2013): Sensors: An Introductory Course. Springer US, New York, NY.
- Lin, Y. L. et al (eds.) (2015): Smart Sensors and Systems. Springer International Publishing, Cham.
- Mukhopadhyay, S. C. (ed.) (2016): Next Generation Sensors and Systems. In: Smart Sensors, Measurement and Instrumentation, Vol. 16. Springer International Publishing, Cham.
- Regtien, P./Dertien, E. (2018): Sensors for Mechatronics. 2nd ed., Elsevier, Amsterdam.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Signals and Systems)

Contributing Courses to Module
▪ Signals and Systems (DLBROSS01_E)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 90 Minutes	**Split Exam**
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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programs in the IT & Technology fields

Signals and Systems

Course Code: DLBROSS01_E

Study Level	Language of Instruction	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 Signal Energy
   - 4.4 Applications

5. Sampling
   - 5.1 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

- Alkin, O. (2014): Signals and systems: a MATLAB integrated approach. CRC Press, Boca Raton, FL.
- Lathi, B. P. (2009): Principles of Linear Systems and Signals. 2nd ed., Oxford University Press, New Delhi.
- Rao, K. D. (2018): Signals and Systems. Springer International Publishing, Cham.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

DLBROSS01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programs in the IT & Technology fields

Mechanics - Kinematics

Course Code: DLBROMK01_E

Study Level	Language of Instruction	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 Introduction
   - 3.2 The Denavit-Hartenberg Convention
   - 3.3 Product of Exponentials
   - 3.4 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

- Siciliano, B., & Khatib, O. (Eds.). (2016). Springer Handbook of Robotics. Springer International Publishing, Basel.
- Corke, P. (2017). Robotics, Vision and Control: Fundamental Algorithms In MATLAB® (2nd ed.). Springer International Publishing, Basel.
- Ben-Ari, M., & Mondada, F. (2017). Elements of Robotics. Springer International Publishing, Basel.
- Mihelj, M., Bajd, T., Ude, A., Lenarcic, J., Stanovnik, A., Munih, M., … Šlajpah, S. (2018). Robotics: Second edition. Springer International Publishing, Basel.
- Lynch, K. M. & Park, F. C. (2017). Modern robotics: mechanics, planning, and control. Cambridge University Press , Cambridge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

DLBROMK01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (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

<table>
<tr><td colspan="2">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.</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 IUBH
All Bachelor Programmes in the IT & Technology fields</td></tr>
</table>

Mechanics - Dynamics

Course Code: DLBROMD01_E

Study Level	Language of Instruction	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

- Siciliano, B./Khatib, O. (Eds.) (2016): Springer Handbook of Robotics. Springer International Publishing, Basel.
- Corke, P. (2017): Robotics, Vision and Control: Fundamental Algorithms In MATLAB®. 2nd Edition, Springer International Publishing, Basel.
- Ben-Ari, M./Mondada, F. (2017): Elements of Robotics. Springer International Publishing, Basel.
- Mihelj, M. et al. (2018). Robotics: Second edition. Springer International Publishing, Basel.
- Lynch, K. M./Park, F. C. (2017). Modern robotics: mechanics, planning, and control. Cambridge University Press, Cambridge.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

DLBROMD01_E

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
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 Study Format: Distance Learning Oral Assignment	**Split Exam**
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 self-directed and collaborative learning processes with analog and digital media. ▪ initiate local and virtual cooperation and select suitable methods for shaping cooperation. ▪ assess different forms of communication in relation to the goals and requirements of different situations and reflect one's own communication and argumentation behaviour. ▪ explain potentials for conflict and the role of emotions in conflicts and describe the use of systemic methods in the target- and solution-oriented handling of conflicts. ▪ form an idea of one's own resources, present methods of self-management and self-motivation, and derive appropriate strategies.	
Links to other Modules within the Study Program This module is similar to other modules in the fields of Business Administration & Management	**Links to other Study Programs of IUBH** All Bachelor Programmes in the Business & Management fields

Collaborative Work

Course Code: DLBCSCW01

Study Level	Language of Instruction	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 self-directed and collaborative learning processes with analog and digital media.
- initiate local and virtual cooperation and select suitable methods for shaping cooperation.
- assess different forms of communication in relation to the goals and requirements of different situations and reflect one's own communication and argumentation behaviour.
- explain potentials for conflict and the role of emotions in conflicts and describe the use of systemic methods in the target- and solution-oriented handling of conflicts.
- form an idea of one's own resources, present methods of self-management and self-motivation, and derive appropriate strategies.

Contents

1. Learning for a Networked World in a Networked World
   - 1.1 Requirements and Opportunities of the VUCA World
   - 1.2 Learning, Information, and Dealing with Knowledge and Ignorance
   - 1.3 C-Model: Collective – Collaborative – Continuous – Connected
   - 1.4 Checking Your Own Learning Behaviour

2. Networking and Cooperation
   - 2.1 Finding and Winning Suitable Cooperation Partners
   - 2.2 Sustainable Relationships: Digital Interaction and Building Trust
   - 2.3 Collaboration: Organizing Locally and Virtually and Using Media
   - 2.4 Social Learning: Agile, Collaborative, and Mobile Planning of Learning Processes

Literature
Compulsory Reading
Further Reading ▪ Baber, A. (2015): Strategic connections. The new face of networking in a collaborative world. Amacom, New York. ▪ Goleman, D. (2013): Focus. The hidden driver of excellence. Harper Collins USA, New York. ▪ Kaats, E./Opheij, W. (2014): Creating conditions for promising collaboration. Alliances, networks, chains, strategic partnerships. Springer Management, Berlin. ▪ Lang, M. D. (2019): The guide to reflective practice in conflict resolution. Rowman & Littlefield, Lanham/Maryland. ▪ Martin, S. J./Goldstein, N. J./Cialdini, R. B. (2015): The small BIG. Small changes that spark BIG influence. Profile Books, London.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Oral Assignment

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Programming with C/C++)

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

Module Exam Type	
Module Exam Study Format: Fernstudium 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 IUBH
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	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

- Čukić, I. (2018): Functional programming in C++. Manning, Shelter Island, NY.
- Laaksonen, A. (2017): Guide to Competitive Programming. Springer International Publishing, Cham.
- Siegesmund, M. (2014): Embedded C Programming. Elsevier Inc, Amsterdam.
- Stroustrup, B. (2013): The C++ Programming Language. 4th ed., Addison-Wesley Professional, Amsterdam.
- Tavasalkar, D. (2019): Hands-On Robotics Programming with C ++. Packt Publishing, Birmingham.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Mechatronic Systems)

Contributing Courses to Module

- Mechatronic Systems (DLBROMSY01_E)

Module Exam Type

Module Exam	Split Exam
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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programs in the IT & Technology fields

Mechatronic Systems

Course Code: DLBROMSY01_E

Study Level	Language of Instruction	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 Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

DLBROMSY01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (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 IUBH
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	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

8. Design via Frequency Response
   - 8.1 Transient Response via Gain Adjustment
   - 8.2 PI Compensation
   - 8.3 Lag Compensation
   - 8.4 PD Compensation
   - 8.5 Lead Compensation
   - 8.6 Lead-Lag Compensation and PID compensation
   - 8.7 Design Limitations
   - 8.8 Time-Delay

Literature

Compulsory Reading

Further Reading

- Nise, N. S. (2019): Control systems engineering. 8th ed., John Wiley & Sons, Hoboken, NJ.
- Doyle, J. C./Francis, B. A./Tannenbaum, A. R. (2009): Feedback Control Theory. Dover Publications Inc, Mineola, NY.
- Franklin, G. F./Powell, J. D./Emami-Naeini, A. (2019): Feedback control of dynamic systems. 8th ed., Pearson, London.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

Project: Modeling and Simulation of Robots

Module Code: DLBROPMSR_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	DLBROMK01_E, DLBROMD01_E	BA	5	150 h

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

Module Coordinator

N.N. (Project: Modeling and Simulation of Robots)

Contributing Courses to Module

- Project: Modeling and Simulation of Robots (DLBROPMSR01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Written Assessment: Project Report	

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 IUBH**
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	Contact Hours	CP	Admission Requirements
BA	English		5	DLBROMK01_E, DLBROMD01_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	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Project: Introduction to Robot Control

Course Code: DLBROPIRC01_E

Study Level	Language of Instruction	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	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (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
- Distributed systems and IoT architecture
- Embedded operating systems

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

Embedded Systems

Course Code: DLBROES01_E

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

Course Description

Embedded systems are required to make functional engineering systems operational. 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, and intelligence. In this sense, an embedded system is the place where everything begins. This course provides the basics on embedded systems, by focusing on the architectural patterns of modern systems and platforms. The embedded hardware and software aspects are addressed. An emphasis of this course is given to connectivity and networking aspects to build distributed systems for the internet of things and the industrial internet of things (with the final purpose of conceptualizing cyber-physical systems). The course closes with an overview on existing common embedded operating 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 Design
   - 1.2 Embedded Systems Architecture
   - 1.3 Embedded Systems Models
   - 1.4 Standards, Compilers and Programming Languages

2. Embedded Hardware
   - 2.1 Schematics
   - 2.2 Basic Components
   - 2.3 Embedded Processors
   - 2.4 Board Memory
   - 2.5 Board I/O
   - 2.6 Buses

3. Embedded Software
   - 3.1 Device Drivers
   - 3.2 Scheduling Basics
   - 3.3 State Machines
   - 3.4 Interrupts
   - 3.5 Watchdogs
   - 3.6 Embedded Operating Systems
   - 3.7 Middleware

4. Distributed Systems and IoT Architecture
   - 4.1 Network Interfaces (Ethernet, WiFi, 6LoWPAN, Bluetooth...)
   - 4.2 The Internet Protocol
   - 4.3 Transport Layer Security
   - 4.4 Application Protocols (Message protocols, REST)

5. Embedded Operating Systems
   - 5.1 Task Management
   - 5.2 Scheduler
   - 5.3 Synchronization
   - 5.4 System Resource Separation
   - 5.5 Examples of Embedded Operating Systems

Literature

Compulsory Reading

Further Reading

- Barkalov, A./Titarenko, L./Mazurkiewicz, M. (2019): Foundations of Embedded Systems. In: Kacprzyk, J.: Studies in Systems, Decision and Control, Volume 195, Springer Nature, Chams.
- Lacamera, D. (2018): Embedded systems architecture: explore architectural concepts, pragmatic design patterns, and best practices to produce robust systems. Packt Publishing, Birmingham.
- Noergaard, T. (2013): Embedded Systems Architecture. Elsevier Inc, Amsterdam.
- Siegesmund, M. (2014): Embedded C Programming. Elsevier Inc, Amsterdam.
- Simon, D. E. (1999): An embedded software primer. Addison Wesley, Boston, MS.
- White, E. (2011): Making Embedded Systems. O’Reilly, Sebastopol, CL.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

DLBROES01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Project: Robotics)

Contributing Courses to Module

- Project: Robotics (DLBROPR01_E)

Module Exam Type	
Module Exam Study Format: Fernstudium 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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Project: Robotics

Course Code: DLBROPR01_E

Study Level	Language of Instruction	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 Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Seminar: Human-Robot Interaction)

Contributing Courses to Module
▪ Seminar: Human-Robot Interaction (DLBROSHRI01_E)

Module Exam Type	
Module Exam Study Format: Fernstudium 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 IUBH**
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	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 Fernstudium

Study Format	Course Type
Fernstudium	Seminar

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Project: Applied Robotics with Robotic Platforms)

Contributing Courses to Module

- Project: Applied Robotics with Robotic Platforms (DLBROPARRP01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Fernstudium Oral Project Report	

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

Project: Applied Robotics with Robotic Platforms

Course Code: DLBROPARRP01_E

Study Level	Language of Instruction	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 Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Oral Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Seminar: Robots and Society)

Contributing Courses to Module
▪ Seminar: Robots and Society (DLBROSRS01_E)

Module Exam Type	
Module Exam Study Format: Fernstudium Written Assessment: Research Essay	**Split Exam**
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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Seminar: Robots and Society

Course Code: DLBROSRS01_E

Study Level	Language of Instruction	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 Fernstudium

Study Format	Course Type
Fernstudium	Seminar

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Safety of Industrial Plants and Machines)

Contributing Courses to Module

- Safety of Industrial Plants and Machines (DLBROSIPM01_E)

Module Exam Type

Module Exam	Split Exam
Study Format: Fernstudium Exam, 90 Minutes	

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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programs in the IT & Technology fields

Safety of Industrial Plants and Machines

Course Code: DLBROSIPM01_E

Study Level	Language of Instruction	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. Basics
   - 1.1 Safety Engineering
   - 1.2 Legal Aspects and Product Liability
2. EU Directives, Laws and Standards
   - 2.1 CE Label
   - 2.2 Machinery Directive (Directive 2006/42/EC)

3. Typical Methods for the Identification of Safety Concerns
   - 3.1 FMEA (Failure Mode and Effects Analysis)
   - 3.2 FTA (Fault Tree Analysis)
   - 3.3 Risk Assessment Following EN ISO 12100
4. Security-Related Sensor Technology
   - 4.1 Circuits and Logic
   - 4.2 Redundancy in Electrical, Pneumatic and Hydraulic Systems
5. Declaration of Conformity
   - 5.1 Performance Level (PL)
   - 5.2 Safety Integrity Level (SIL)
   - 5.3 Validation of Security-Related Systems

Literature

Compulsory Reading

Further Reading

- Kessels, U./Muck, S. (2020): Risikobeurteilung gemäß 2006/42/EG. Handlungshilfe und Potentiale. 4., überarbeitete und aktualisierte Auflage, Beuth Verlag, Berlin.
- Werdich, M. (2012): FMEA - Einführung und Moderation. Durch systematische Entwicklung zur übersichtlichen Risikominimierung (inkl. Methoden im Umfeld). 2. Auflage, Vieweg+Teubner Verlag, Wiesbaden.
- Schneider, A. (2018): Zertifizierung im Rahmen der CE-Kennzeichnung. Konformitätsbewertung und Risikobeurteilung nach der Maschinenrichtlinie 2006/42/EG und anderen europäischen Richtlinien. 5., neu bearbeitete Auflage, VDE VERLAG GmbH, Berlin.
- Schucht, C./Berger, N. (2019): Praktische Umsetzung der Maschinenrichtlinie. Risikobeurteilung - Verkehrsfähigkeit - Schulungen - Audits - Wesentliche Veränderung – Rechtsprechung. 2., aktualisierte Auflage, Carl Hanser Verlag, München.
- Krey, V./Kapoor, A. (2017): Praxisleitfaden Produktsicherheitsrecht. CE-Kennzeichnung - Risikobeurteilung - Betriebsanleitung - Konformitätserklärung - Produkthaftung – Fallbeispiele. 3. Auflage, Carl Hanser Verlag, München.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

DLBROSIPM01_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Handling Technology) / N.N. (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 (50) Automation Technology • Study Format "Distance Learning": Exam (50)
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 IUBH
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	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

- Haun, M. (2013): Handbuch Robotik. Programmieren und Einsatz intelligenter Roboter. 2. Auflage, Springer Vieweg Verlag, Berlin.
- Hesse, S. (2016): Grundlagen der Handhabungstechnik. 4., überarbeitete und erweiterte Auflage, Carl Hanser Verlag, München.
- Hesse, S. (2016): Taschenbuch. Robotik - Montage – Handhabung. 2., neu bearbeitete Auflage, Carl Hanser Verlag, München.
- Maier, H. (2016): Grundlagen der Robotik. VDE Verlag GmbH, Berlin.
- Wolf, A./Schunk, H. (2016): Greifer in Bewegung. Faszination der Automatisierung von Handhabungsaufgaben. 2. Auflage, Carl Hanser Verlag, München.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☐ Live Tutorium/Course Feed

Automation Technology

Course Code: DLBROEIRA02_E

Study Level	Language of Instruction	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

- Gupta, A. K./Arora, S. K./Westcott, J. R. (2016): Industrial automation and robotics. Mercury Learning & Information, Herndon, VA.
- Mehta, B. R./Reddy, Y. J. (2014): Industrial process automation systems: Design and implementation. Elsevier Inc, Amsterdam.
- Merz, H./Hansemann, T./Hübner, C. (2018): Building Automation. Springer International Publishing, Cham.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Mobile Robotics) / N.N. (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": Module Exam (50) Soft Robotics • Study Format "Distance Learning": Exam (50)
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 This module is similar to other modules in the field of Engineering	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Mobile Robotics

Course Code: DLBROESR01_E

Study Level	Language of Instruction	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
   - 2.3 Mobile Robot Maneuverability
   - 2.4 Mobile Robot Workspace
   - 2.5 Applications

3. Dynamics
   - 3.1 Basics
   - 3.2 Dynamic Modeling
   - 3.3 Examples

4. Perception
   - 4.1 Sensors for Mobile Robots
   - 4.2 Position and Velocity Sensors
   - 4.3 Accelerometers
   - 4.4 Inertial Measurement Unit
   - 4.5 Distance Sensors
   - 4.6 Vision Sensors
   - 4.7 Robot Vision and Image Processing
   - 4.8 Global Positioning System

5. Mobile Manipulators
   - 5.1 Basics
   - 5.2 Modeling
   - 5.3 Examples

6. Path, Motion and Task Planning
   - 6.1 Basics
   - 6.2 Path Planning
   - 6.3 Motion Planning
   - 6.4 Task Planning

7. Localization and Mapping
   - 7.1 Sensor Imperfections
   - 7.2 Relative Localization
   - 7.3 Absolute Localization
   - 7.4 Localization, Calibration and Sensor Fusion
   - 7.5 Simultaneous Localization and Mapping
   - 7.6 Examples

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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Module Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Soft Robotics

Course Code: DLBROESR02_E

Study Level	Language of Instruction	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 Materials and Properties of Soft Actuators
   - 2.2 Thermo-driven Soft Actuators
   - 2.3 Electro-driven Soft Actuators
   - 2.4 Light-driven Soft Actuators
   - 2.5 Magneto-driven Soft Actuators
   - 2.6 Pneumatic Actuators
   - 2.7 Examples

3. Sensors
   - 3.1 Basics
   - 3.2 Proximity Sensing
   - 3.3 Mechano-sensing
   - 3.4 Examples

4. Modeling
   - 4.1 Artificial Muscles
   - 4.2 Interactions
   - 4.3 Compliance Control
   - 4.4 Variable-stiffness Actuators

5. Applications
   - 5.1 Soft Bionic Hands
   - 5.2 Healthcare and Surgery
   - 5.3 Underwater and Aquatic Propulsion
   - 5.4 Bio-inspired Aerial Robots

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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

DLBROESR02_E

Introduction to Cognitive Robotics

Module Code: DLBROEICR_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Digital Signal Processing) / N.N. (Fundamentals of NLP and Computer Vision)

Contributing Courses to Module
▪ Digital Signal Processing (DLBROEICR01_E) ▪ Fundamentals of NLP and Computer Vision (DLBROEICR02_E)

Module Exam Type	
Module Exam	**Split Exam** <u>Digital Signal Processing</u> • Study Format "Distance Learning": Exam, 90 Minutes (50) <u>Fundamentals of NLP and Computer Vision</u> • Study Format "Distance Learning": Exam, 90 Minutes (50)
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

Fundamentals of NLP and Computer Vision

- Introduction to Natural Language Processing
- Introduction to Computer Vision
- Applications to Robotics

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.

Fundamentals of NLP and Computer Vision

On successful completion, students will be able to

- name central problems and challenges in natural language processing and computer vision.
- understand common methods used in natural language processing and computer vision.
- name common use-case scenarios in which NLP and computer vision techniques are applied.
- design basic language processing and computer vision solutions for use in robotics.

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

Digital Signal Processing

Course Code: DLBROEICR01_E

Study Level	Language of Instruction	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
    3.1 Digital Signals
    3.2 Difference Equations and Impulse Responses
    3.3 BIBO-Stability
    3.4 Digital Convolution

4. Discrete Fourier Transform
    4.1 Discrete Fourier Transform
    4.2 Amplitude and Power Spectrum
    4.3 Spectral Estimation

5. The z-Transform
    5.1 Definition
    5.2 Properties
    5.3 Inverse z-Transform
    5.4 Solution of Difference Equations

6. Digital Signal Processing Systems and Filters
    6.1 Difference Equation and Transfer Function
    6.2 Poles, Zeros and Stability
    6.3 Digital Filter Frequency Response
    6.4 Basic Filtering
    6.5 Realization of Digital Filters
    6.6 Applications

7. Finite Impulse Response Filter Design
    7.1 Basics
    7.2 Fourier Transform Design
    7.3 Window Method
    7.4 Frequency Sampling Design Method
    7.5 Optimal Design Method
    7.6 Applications

8. Infinite Impulse Response Filter Design
   - 8.1 Basics
   - 8.2 Bilinear Transformation Design Method
   - 8.3 Butterworth and Chebyschev Filter Designs
   - 8.4 Higher-Order Infinite Impulse Response Filter Design
   - 8.5 Pole-Zero Placement for Simple Filters
   - 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Fundamentals of NLP and Computer Vision

Course Code: DLBROEICR02_E

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

Course Description

Innovative robots, belonging to the so-called generation 3.0, need to sense and understand the environment in many ways, for instance using vision and language understanding and processing. This course introduces the topics of natural language processing (NLP) and computer vision, discussing the main techniques of both fields as well as their application in the field of robotics.

Course Outcomes

On successful completion, students will be able to

- name central problems and challenges in natural language processing and computer vision.
- understand common methods used in natural language processing and computer vision.
- name common use-case scenarios in which NLP and computer vision techniques are applied.
- design basic language processing and computer vision solutions for use in robotics.

Contents

1. Introduction to NLP
   - 1.1 History
   - 1.2 Basics Concepts of NLP
   - 1.3 Feature Extraction Methods
2. Applications of NLP
   - 2.1 Topic Modeling
   - 2.2 Text Summarization and Generation
   - 2.3 Sentiment Analysis
   - 2.4 Translation
   - 2.5 Chatbots
3. Introduction to Computer Vision
   - 3.1 Light and Color
   - 3.2 Image Formation
   - 3.3 Image Processing
   - 3.4 Image Feature Extraction
   - 3.5 Stereo Vision

Literature

Compulsory Reading

Further Reading

- Bird S., Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O'Reilly, Sebastopol, CA.
- Fisher, R. B., et al (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ.
- Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

DLBROEICR02_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Handling Technology) / N.N. (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 (50) Automation Technology • Study Format "Distance Learning": Exam (50)
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 IUBH
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	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

- Haun, M. (2013): Handbuch Robotik. Programmieren und Einsatz intelligenter Roboter. 2. Auflage, Springer Vieweg Verlag, Berlin.
- Hesse, S. (2016): Grundlagen der Handhabungstechnik. 4., überarbeitete und erweiterte Auflage, Carl Hanser Verlag, München.
- Hesse, S. (2016): Taschenbuch. Robotik - Montage – Handhabung. 2., neu bearbeitete Auflage, Carl Hanser Verlag, München.
- Maier, H. (2016): Grundlagen der Robotik. VDE Verlag GmbH, Berlin.
- Wolf, A./Schunk, H. (2016): Greifer in Bewegung. Faszination der Automatisierung von Handhabungsaufgaben. 2. Auflage, Carl Hanser Verlag, München.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Automation Technology

Course Code: DLBROEIRA02_E

Study Level	Language of Instruction	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

- Gupta, A. K./Arora, S. K./Westcott, J. R. (2016): Industrial automation and robotics. Mercury Learning & Information, Herndon, VA.
- Mehta, B. R./Reddy, Y. J. (2014): Industrial process automation systems: Design and implementation. Elsevier Inc, Amsterdam.
- Merz, H./Hansemann, T./Hübner, C. (2018): Building Automation. Springer International Publishing, Cham.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Mobile Robotics) / N.N. (Soft Robotics)

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

Module Exam Type	
Module Exam	**Split Exam** <u>Mobile Robotics</u> • Study Format "Distance Learning": Module Exam (50) <u>Soft Robotics</u> • Study Format "Distance Learning": Exam (50)
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 IUBH
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	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
    - 2.3 Mobile Robot Maneuverability
    - 2.4 Mobile Robot Workspace
    - 2.5 Applications

3. Dynamics
    - 3.1 Basics
    - 3.2 Dynamic Modeling
    - 3.3 Examples

4. Perception
    - 4.1 Sensors for Mobile Robots
    - 4.2 Position and Velocity Sensors
    - 4.3 Accelerometers
    - 4.4 Inertial Measurement Unit
    - 4.5 Distance Sensors
    - 4.6 Vision Sensors
    - 4.7 Robot Vision and Image Processing
    - 4.8 Global Positioning System

5. Mobile Manipulators
    - 5.1 Basics
    - 5.2 Modeling
    - 5.3 Examples

6. Path, Motion and Task Planning
    - 6.1 Basics
    - 6.2 Path Planning
    - 6.3 Motion Planning
    - 6.4 Task Planning

7. Localization and Mapping
   - 7.1 Sensor Imperfections
   - 7.2 Relative Localization
   - 7.3 Absolute Localization
   - 7.4 Localization, Calibration and Sensor Fusion
   - 7.5 Simultaneous Localization and Mapping
   - 7.6 Examples

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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Module Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Soft Robotics

Course Code: DLBROESR02_E

Study Level	Language of Instruction	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 Materials and Properties of Soft Actuators
   - 2.2 Thermo-driven Soft Actuators
   - 2.3 Electro-driven Soft Actuators
   - 2.4 Light-driven Soft Actuators
   - 2.5 Magneto-driven Soft Actuators
   - 2.6 Pneumatic Actuators
   - 2.7 Examples

3. Sensors
   3.1 Basics
   3.2 Proximity Sensing
   3.3 Mechano-sensing
   3.4 Examples

4. Modeling
   4.1 Artificial Muscles
   4.2 Interactions
   4.3 Compliance Control
   4.4 Variable-stiffness Actuators

5. Applications
   5.1 Soft Bionic Hands
   5.2 Healthcare and Surgery
   5.3 Underwater and Aquatic Propulsion
   5.4 Bio-inspired Aerial Robots

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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☐ Live Tutorium/Course Feed

Introduction to Cognitive Robotics

Module Code: DLBROEICR_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Digital Signal Processing) / N.N. (Fundamentals of NLP and Computer Vision)

Contributing Courses to Module
▪ Digital Signal Processing (DLBROEICR01_E) ▪ Fundamentals of NLP and Computer Vision (DLBROEICR02_E)

Module Exam Type	
Module Exam	**Split Exam** Digital Signal Processing • Study Format "Distance Learning": Exam, 90 Minutes (50) Fundamentals of NLP and Computer Vision • Study Format "Distance Learning": Exam, 90 Minutes (50)

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 **Fundamentals of NLP and Computer Vision** ▪ Introduction to Natural Language Processing ▪ Introduction to Computer Vision ▪ Applications to Robotics	
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. **Fundamentals of NLP and Computer Vision** On successful completion, students will be able to ▪ name central problems and challenges in natural language processing and computer vision. ▪ understand common methods used in natural language processing and computer vision. ▪ name common use-case scenarios in which NLP and computer vision techniques are applied. ▪ design basic language processing and computer vision solutions for use in robotics.	
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 IUBH** All Bachelor Programmes in the IT & Technology fields

Digital Signal Processing

Course Code: DLBROEICR01_E

Study Level	Language of Instruction	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
   - 3.1 Digital Signals
   - 3.2 Difference Equations and Impulse Responses
   - 3.3 BIBO-Stability
   - 3.4 Digital Convolution

4. Discrete Fourier Transform
   - 4.1 Discrete Fourier Transform
   - 4.2 Amplitude and Power Spectrum
   - 4.3 Spectral Estimation

5. The z-Transform
   - 5.1 Definition
   - 5.2 Properties
   - 5.3 Inverse z-Transform
   - 5.4 Solution of Difference Equations

6. Digital Signal Processing Systems and Filters
   - 6.1 Difference Equation and Transfer Function
   - 6.2 Poles, Zeros and Stability
   - 6.3 Digital Filter Frequency Response
   - 6.4 Basic Filtering
   - 6.5 Realization of Digital Filters
   - 6.6 Applications

7. Finite Impulse Response Filter Design
   - 7.1 Basics
   - 7.2 Fourier Transform Design
   - 7.3 Window Method
   - 7.4 Frequency Sampling Design Method
   - 7.5 Optimal Design Method
   - 7.6 Applications

8. Infinite Impulse Response Filter Design
    - 8.1 Basics
    - 8.2 Bilinear Transformation Design Method
    - 8.3 Butterworth and Chebyschev Filter Designs
    - 8.4 Higher-Order Infinite Impulse Response Filter Design
    - 8.5 Pole-Zero Placement for Simple Filters
    - 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Fundamentals of NLP and Computer Vision

Course Code: DLBROEICR02_E

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

Course Description

Innovative robots, belonging to the so-called generation 3.0, need to sense and understand the environment in many ways, for instance using vision and language understanding and processing. This course introduces the topics of natural language processing (NLP) and computer vision, discussing the main techniques of both fields as well as their application in the field of robotics.

Course Outcomes

On successful completion, students will be able to

- name central problems and challenges in natural language processing and computer vision.
- understand common methods used in natural language processing and computer vision.
- name common use-case scenarios in which NLP and computer vision techniques are applied.
- design basic language processing and computer vision solutions for use in robotics.

Contents

1. Introduction to NLP
   - 1.1 History
   - 1.2 Basics Concepts of NLP
   - 1.3 Feature Extraction Methods

2. Applications of NLP
   - 2.1 Topic Modeling
   - 2.2 Text Summarization and Generation
   - 2.3 Sentiment Analysis
   - 2.4 Translation
   - 2.5 Chatbots

3. Introduction to Computer Vision
   - 3.1 Light and Color
   - 3.2 Image Formation
   - 3.3 Image Processing
   - 3.4 Image Feature Extraction
   - 3.5 Stereo Vision

4. Applications of Computer Vision
   - 4.1 Image Classification, Motion Tracking
   - 4.2 Semantic Segmentation
   - 4.3 Object Identification and Tracking
   - 4.4 Eigenfaces and Facial Recognition

5. NLP and Computer Vision in Robotics
   - 5.1 Camera Calibration
   - 5.2 Pose Estimation
   - 5.3 Visual Servoing
   - 5.4 Human-Robot Interaction
   - 5.5 Privacy Issues

Literature

Compulsory Reading

Further Reading

- Bird S., Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O'Reilly, Sebastopol, CA.
- Fisher, R. B., et al (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ.
- Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden.

Study Format Distance Learning

Study Format	**Course Type**
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

DLBROEICR02_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Ulrich Kerzel (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** <u>Artificial Intelligence</u> • Study Format "Distance Learning": Exam, 90 Minutes <u>Project: Artificial Intelligence</u> • Study Format "Fernstudium": Portfolio
Weight of Module see curriculum	

Module Contents
Artificial Intelligence ▪ 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** ▪ 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.

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.

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

Artificial Intelligence

Course Code: DLBDSEAIS01

Study Level	Language of Instruction	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 Pixels and filters
   - 5.2 Feature detection
   - 5.3 Distortions and calibration
   - 5.4 Semantic segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F./Barry, W./Paradiso, M. (2006): Neuroscience: Exploring the brain. 3rd ed., Lippincott Williams and Wilkins, Baltimore, MD:
- Bird S./Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O‘Reilly, Sebastopol, CA.
- Chollet, F. (2017): Deep learning with Python. Manning, Shelter Island, NY.
- Fisher, R. B., et al. (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- Geron, A. (2017): 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.
- Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ.
- Nilsson, N. (2009): The quest for artificial intelligence. Cambridge University Press, Cambridge.
- Russell, S./Norvig, P. (2009): Artificial intelligence: A modern approach. 3rd ed., Pearson, Essex.
- Sutton, R./Barto, A. (2018): Reinforcement learning: An introduction. 2nd ed., MIT Press, Boston, MA.
- Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden.
- Szepesvári, C. (2010): Algorithms for reinforcement learning. Morgan & Claypool, San Rafael, CA.
- Wiering, M./Otterlo, M. (2012): Reinforcement learning: State of the art. Springer, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

Project: Artificial Intelligence

Course Code: DLBDSEAIS02

Study Level	Language of Instruction	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. (2006): Neuroscience: Exploring the brain. 3rd ed., Lippincott Williams and Wilkins, Baltimore, MD: ▪ Bird S./Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O'Reilly, Sebastopol, CA. ▪ Chollet, F. (2017): Deep learning with Python. Manning, Shelter Island, NY. ▪ Fisher, R. B., et al. (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester. ▪ Geron, A. (2017): 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. ▪ Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ. ▪ Nilsson, N. (2009): The quest for artificial intelligence. Cambridge University Press, Cambridge. ▪ Russell, S./Norvig, P. (2009): Artificial intelligence: A modern approach. 3rd ed., Pearson, Essex. ▪ Sutton, R./Barto, A. (2018): Reinforcement learning: An introduction. 2nd ed., MIT Press, Boston, MA. ▪ Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden. ▪ Szepesvári, C. (2010): Algorithms for reinforcement learning. Morgan & Claypool, San Rafael, CA. ▪ Wiering, M./Otterlo, M. (2012): Reinforcement learning: State of the art. Springer, Berlin.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Self-Driving Vehicles) / N.N. (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 "Distance Learning": Exam, 90 Minutes (50) Seminar: Current Topics and Trends in Self-Driving Technology • Study Format "Distance Learning": Written Assessment: Research Essay (50)
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 IUBH
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	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 calibaration
   - 1.4 Application scenarios

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

3. Computer Vision
   - 3.1 Pixels and filters
   - 3.2 Feature detection
   - 3.3 Distortions and calibration
   - 3.4 Semantic segmentation

4. Localization & Motion
   - 4.1 Motion models
   - 4.2 Odometry
   - 4.3 Triangulation
   - 4.4 Satellite-based localization

5. Motion planning
   - 5.1 Path planning
   - 5.2 Motion prediction
   - 5.3 Trajectory generation

6. Safety Standards
   - 6.1 Functional Safety
   - 6.2 IT Security Standards
   - 6.3 Safety development approaches

Literature
Compulsory Reading
Further Reading

Further Reading

- Ben-Ari, M./Mondada, F. (2018): Elements of robotics. Springer, Cham.
- European Union. (2001).:Directive 2001/95/EG. (URL: https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32001L0095 [Retrieved: 28.02.2020])
- Fisher, R. B., et al. (2016): Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- International Electrotechnical Commission. (2015): IEC 61508. (URL: https://www.iec.ch/functionalsafety/ [Retrieved: 28.02.2020])
- International Organization for Standardization. (2009): ISO 15408. (URL: https://www.iso.org/standard/50341.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (2018): ISO 25119. (URL: https://www.iso.org/standard/69026.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (2018): ISO 26262. (URL: https://www.iso.org/standard/68383.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (n.d.): ISO 21434. (URL: https://www.iso.org/standard/70918.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (2018): ISO/IEC 27001. (URL: https://www.iso.org/isoiec-27001-information-security.html [Retrieved: 28.02.2020])
- Rausand, M. (2014): Reliability of safety-critical systems: Theory and applications. Wiley, Hoboken, NJ.
- 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. (URL: https://www.sae.org/standards/content/j3061/ [Retrieved: 28.02.2020])
- Szelski, R. (2011): 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

Seminar: Current Topics and Trends in Self-Driving Technology

Course Code: DLBDSEAD02

Study Level	Language of Instruction	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. (URL: https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32001L0095 [Retrieved: 28.02.2020]) ▪ Fisher, R. B., et al. (2016): Dictionary of computer vision and image processing. John Wiley & Sons, Chichester. ▪ International Electrotechnical Commission. (2015): IEC 61508. (URL: https://www.iec.ch/functionalsafety/ [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2009): ISO 15408. (URL: https://www.iso.org/standard/50341.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2018): ISO 25119. (URL: https://www.iso.org/standard/69026.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2018): ISO 26262. (URL: https://www.iso.org/standard/68383.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (n.d.): ISO 21434. (URL: https://www.iso.org/standard/70918.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2018): ISO/IEC 27001. (URL: https://www.iso.org/isoiec-27001-information-security.html [Retrieved: 28.02.2020]) ▪ Marchthaler, R./Dingler, S. (2017): Kalman-Filter. Springer, Wiesbaden. ▪ Rausand, M. (2014): Reliability of safety-critical systems: Theory and applications. Wiley, Hoboken, NJ. ▪ 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. (URL: https://www.sae.org/standards/content/j3061/ [Retrieved: 28.02.2020]) ▪ Szelski, R. (2011): 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	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Data Analytics and Big Data) / N.N. (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 "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 This module is similar to other modules in the fields of Data Science & Artificial Intelligence	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Data Analytics and Big Data

Course Code: DLBINGDABD01_E

Study Level	Language of Instruction	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
   - 1.5 Internet of Things as Driver for Big Data

Literature
Compulsory Reading
Further Reading ▪ Brandt, S. (2013): Datenanalyse für Naturwissenschaftler und Ingenieure. Mit statistischen Methoden und Java-Programmen. 5. Auflage, Springer, Wiesbaden. ▪ Dorschel, J. (Hrsg.) (2015): Praxishandbuch Big Data. Wirtschaft – Recht – Technik. Springer Gabler Wiesbaden. ▪ Gandomi, A./Haider, M. (2015): Beyond the hype. Big data concepts, methods, and analytics. In: International Journal of Information Management, 35. Jg., Heft 2, S. 137–144. ▪ Provost, F./Fawcett, T. (2013): Data science for business. What You Need to Know About Data Mining and Data-Aalytic Thinking. O'Reilly, Sebastopol (CA). ▪ Runkler, T. A. (2015): Data Mining. Modelle und Algorithmen intelligenter Datenanalyse. 2. Auflage, Springer Vieweg, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Case Study

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☑ Live Tutorium/Course Feed

Deep Learning

Course Code: DLBDBDL01_E

Study Level	Language of Instruction	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
   - 2.4 Types of 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

DLBDBDL01_E

Python for Software Engineering

Module Code: DLBROEPSE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLBDSIPWP01 or DLBDSIPWP01_D; DLBDSOOFPP01 or IOBP01 ▪ none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction
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 (50) <u>Data Science Software Engineering</u> • Study Format "Distance Learning": Exam, 90 Minutes (100)
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 IUBH
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	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, Sebastopol, CA. ▪ 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, Birmingham. ▪ Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly, Sebastopol, CA.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☑ Live Tutorium/Course Feed

Data Science Software Engineering

Course Code: DLBDSDSSE01

Study Level	Language of Instruction	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

- Farcic, V. (2016): The DevOps 2.0 toolkit: Automating the continuous deployment pipeline with containerized microservices. CreateSpace Independent Publishing Platform, Scotts Valley, CA.
- Humble, J./Farley, D. (2010): Continuous delivery: Reliable software releases through build, test, and deployment automation. Addison-Wesley Professional, Boston, MA.
- Humble, J./Molesky, J./O'Reilly, B. (2015): Lean enterprise. O'Reilley Publishing, Sebastopol, CA.
- Hunt, A./Thomas, D. (1999): The pragmatic programmer. From journeyman to master. Addison-Wesley, Reading, MA.
- Martin, R. C. (2008): Clean code. Prentice Hall, Boston, MA.
- Morris, K. (2016): Infrastructure as code. O'Reilley Publishing, Sebastopol, CA.
- Richardson, L./Ruby, S. (2007): RESTful web services. O'Reilley Publishing, Sebastopol, CA.
- Senge, P. (1990): The fifth discipline: The art and practice of the learning organization. Broadway Business, New York, NY.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☑ Live Tutorium/Course Feed

IT Security

Module Code: DLBROEITS_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Ralf Kneuper (Introduction to Data Protection and Cyber Security) / N.N. (Cryptography)

Contributing Courses to Module
▪ Introduction to Data Protection and Cyber Security (DLBCSIDPITS01) ▪ Cryptography (DLBCSCT01)

Module Exam Type	
Module Exam	**Split Exam** Introduction to Data Protection and Cyber Security • Study Format "Distance Learning": Exam, 90 Minutes Cryptography • Study Format "Distance Learning": Exam, 90 Minutes
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 IUBH
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	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

- Eckert, C. (2014): IT-Sicherheit. Konzepte – Verfahren – Protokolle. 9. Auflage, De Gruyter, München.
- Poguntke, W. (2013): Basiswissen IT-Sicherheit. Das Wichtigste für den Schutz von Systemen & Daten. 3. Auflage, W3l, Dortmund.
- Witt, B. C. (2010): Datenschutz kompakt und verständlich. 2. Auflage, Vieweg+Teubner, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Cryptography

Course Code: DLBCSCT01

Study Level	Language of Instruction	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
   - 3.3 Message Authentication Code
   - 3.4 Steganographic Methods

4. Authentication
   - 4.1 Passwords and Public-Key-Certificates
   - 4.2 Challenge-Response-Procedure and Zero-Knowledge-Procedure
   - 4.3 Biometric Methods
   - 4.4 Authentication in Distributed Systems
   - 4.5 Identities Through Smartcards

5. Security of Single Computers
   - 5.1 Malware and Cookies
   - 5.2 Some Special Features of Operating Systems
   - 5.3 Web Server Security

6. Security in Communication Networks
   - 6.1 Security Problems and Defense Concepts
   - 6.2 Internet Standards for Communication Security
   - 6.3 Identity and Anonymity
   - 6.4 Security in Mobile and Wireless Communications

7. Security in E-Commerce
   - 7.1 Email Security
   - 7.2 Online Banking and Online Payments
   - 7.3 Electronic Money

8. Secure Software Development
   - 8.1 Threat Modeling
   - 8.2 Secure Software Design
   - 8.3 Techniques for Safe Programming

Literature
Compulsory Reading
Further Reading ▪ Baumann, U./Franz, E./Pfitzmann, A. (2014): Kryptographische Systeme. Springer Vieweg, Wiesbaden. ▪ Beutelspacher, A. (2014): Kryptologie. Eine Einführung in die Wissenschaft vom Verschlüsseln, Verbergen und Verheimlichen. 10. Auflage, Springer Spektrum, Wiesbaden. ▪ Eckert, C. (2014): IT-Sicherheit. Konzepte – Verfahren – Protokolle. 9. Auflage, De Gruyter Oldenbourg, München. ▪ Ertel, W. (2010): Angewandte Kryptographie. 4. Auflage, Hanser, München. ▪ Spitz, S./Pramateftakis, M./Swoboda, J. (2011): Kryptographie und IT-Sicherheit. Grundlagen und Anwendungen. 2. Auflage, Vieweg+Teubner; Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☐ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☐ Live Tutorium/Course Feed

Mobile Software Engineering

Module Code: IWMB_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Mobile Software Engineering) / N.N. (Project: Mobile Software Engineering)

Contributing Courses to Module
▪ Mobile Software Engineering (IWMB01_E) ▪ Project: Mobile Software Engineering (IWMB02_E)

Module Exam Type	
Module Exam	**Split Exam** Mobile Software Engineering • Study Format "Distance Learning": Exam, 90 Minutes (50) Project: Mobile Software Engineering • Study Format "Fernstudium": Written Assessment: Project Report (49)
Weight of Module see curriculum	

Module Contents	
Mobile Software Engineering ▪ Basics of Mobile Software Development ▪ Android System Architecture ▪ Programming Environment ▪ Core Components of Android Apps ▪ Interaction between Application Components ▪ Advanced Methods **Project: Mobile Software Engineering** Design, implementation and documentation of small, mobile applications based on a specific example.	
Learning Outcomes **Mobile Software Engineering** On successful completion, students will be able to ▪ recognize and describe the variances and specific features of software development for mobile systems. ▪ distinguish between different activities, parts and risks in the creation, operation and maintenance of mobile software systems . ▪ explain and differentiate the architecture and technical features of the Android Platform. ▪ autonomously create mobile software systems to solve concrete problems for the Android Platform . **Project: Mobile Software Engineering** On successful completion, students will be able to ▪ autonomously design and prototype small mobile applications to solve a specific task. ▪ identify typical problems and challenges in the practical implementation of small mobile applications. ▪ document the creation and implementation of small, autonomously 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	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Mobile Software Engineering

Course Code: IWMB01_E

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

Course Description

Using the mobile platform Android as an example, the course explains how the programming of mobile applications (Apps) differs from the development of browser-based information systems, gives an overview of technologies and programming concepts deployed and describes common challenges in the development of apps for industrial applications.

Course Outcomes

On successful completion, students will be able to

- recognize and describe the variances and specific features of software development for mobile systems.
- distinguish between different activities, parts and risks in the creation, operation and maintenance of mobile software systems .
- explain and differentiate the architecture and technical features of the Android Platform.
- autonomously 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 Security Features
   - 2.3 Communication with Networks

3. Programming Environment
   - 3.1 Android Studio
   - 3.2 First App and Emulator Test
   - 3.3 Application Deployment

4. Core Components of Android Apps
   - 4.1 Overview of Android App Components
   - 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 Receive

6. Advanced Methods
   - 6.1 Threading
   - 6.2 Application memory

Literature

Compulsory Reading

Further Reading

- Eason, J. (2014): Android Studio 1.0. (URL: https://android-developers.googleblog.com/2014/12/android-studio-10.html [letzter Zugriff: 12.06.2015]).
- Google Inc. (Hrsg.) (2015): Android Developer Guide. (URL: http://developer.android.com/guide)
- Google Inc. (Hrsg.) (2015): App Components. (URL: http://developer.android.com/guide/components/index.html [letzter Zugriff: 12.06.2015]).
- Google Inc. (Hrsg.) (2015): Installing the Android SDK. (URL: http://developer.android.com/sdk/installing/index.html [letzter Zugriff: 13.05.2015]).
- Google Inc. (Hrsg.) (2015): Resources Overview. (URL: http://developer.android.com/guide/topics/resources/overview.html [letzter Zugriff: 12.06.2015]).
- Hipp, Wyrick & Company, Inc. (Hrsg.) (2015): SQLite Webseite. (URL: http://sqlite.org/index.html [letzter Zugriff: 12.06.2015]).

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Project: Mobile Software Engineering

Course Code: IWMB02_E

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

Course Description

With the material conveyed in the course "Mobile Software Engineering Using the Android Platform as an Example", students autonomously create a mobile application and document its design and implementation.

Course Outcomes

On successful completion, students will be able to

- autonomously design and prototype small mobile applications to solve a specific task.
- identify typical problems and challenges in the practical implementation of small mobile applications.
- document the creation and implementation of small, autonomously designed and implemented mobile applications .

Contents

- Design, implementation and documentation of small, mobile applications based on a specific example. Possible topics are, for example:
  - A radio app to improve the exchange between listeners and station in general, and particularly between listeners and radio presenters.
  - An app that allows a group of board game fans to better organize their regular evening game schedule.
  - An app that enables the supervisors of assignments at IUBH to improve their support procedures.

Literature
Compulsory Reading
Further Reading

- Becker, A./Pant, M. (2015): Android 5. Programmieren für Smartphones und Tablets. 4. Auflage, dpunkt, Heidelberg.
- Eason, J. (2014): Android Studio 1.0. (URL: http://android-developers.blogspot.de/2014/12/android- studio-10.html [letzter Zugriff: 12.06.2015]).
- Franke, F./Ippen, J. (2012): Apps mit HTML5 und CSS3. Rheinwerk Verlag, Bonn.
- Google Inc. (Hrsg.) (2015): Android Developer Guide. (URL: http://developer.android.com/guide)
- Google Inc. (Hrsg.) (2015a): App Components. (URL: http://developer.android.com/guide/components/ index.html [letzter Zugriff: 12.06.2015]).
- Google Inc. (Hrsg.) (2015b): Installing the Android SDK. (URL: http://developer.android.com/sdk/ installing/index.html [letzter Zugriff: 13.05.2015]).
- Google Inc. (Hrsg.) (2015c): Resources Overview. (URL: http://developer.android.com/guide/topics/ resources/overview.html [letzter Zugriff: 12.06.2015]).
- Hipp, Wyrick & Company, Inc. (Hrsg.) (2015): SQLite Webseite. (URL: http://sqlite.org/index.html [letzter Zugriff: 12.06.2015]).
- Künneth, T. (2016): Android 7. Das Praxisbuch für Entwickler. 4. Auflage, Rheinwerk, Bonn.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☐ Course Book	☐ Creative Lab
☐ Vodcast	☑ Guideline
☐ Shortcast	☐ Live Tutorium/Course Feed
☐ Audio	
☐ Exam Template	

Foreign Language Italian

Module Code: DLFLI

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language Italian)

Contributing Courses to Module
▪ Foreign Language Italian (DLFLI01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Depending on the CEFR classification, students are qualified to
  - understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves – e.g. where they live, who they know, or what things they have – and answer questions of this kind. They can communicate in a simple way if the other party speaks slowly and clearly and is willing to help. (Level A1)**
  - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, and local area). They can communicate in simple, routine situations that involve a simple and direct exchange of information about familiar and common things. They can use simple language to describe their own background and education, their immediate environment, and things related to immediate needs. (Level A2)**
  - understand the main points when clear standard language is used and when it comes to familiar matters from work, school, and leisure, etc. They can cope with most situations encountered when traveling in an area where the language is spoken. They can express themselves simply and coherently on familiar topics and personal areas of interest. They can report on experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for their plans and views. (Level B1) **
  - understand the main contents of complex texts on concrete and abstract topics and, in their own field, also technical discussions. They can communicate so spontaneously and fluently that a normal conversation with native speakers is possible without much effort on both sides. They can express themselves clearly and in detail on a wide range of topics, explain a point of view on a topical issue, and indicate the advantages and disadvantages of different options. (Level B2) **
  - understand a wide range of demanding, longer texts and grasp implicit meanings. They can express themselves spontaneously and fluently without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. They can express themselves in a clear, structured, and detailed manner on complex issues, using various means of text linking appropriately. (Level C1)***
- Grammar:
  - Level A1 – includes present and past tenses, sentence construction, and prepositions, etc.
  - Level A2 – includes historical tenses, differences in times of the past, imperative, subordinate clauses, and pronouns (dative, accusative)
  - Level B1 - among others, an introduction of the pluperfect, conjunctions, the passive, adverbs, adjectives (difference), and the future tense
  - Level B2 - includes verb constructions, conditional sentences, and indirect speech, etc.
  - Level C1 - Exercises to consolidate and repeat what has been learned
- **Source:
  http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp
  and
  http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf
- *** Source:
  http://www.goethe.de/z/50/commeuro/303.htm

Learning Outcomes	
Foreign Language Italian On successful completion, students will be able to	
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 IUBH** All Distance Learning Bachelor Programmes

Foreign Language Italian

Course Code: DLFLI01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

The qualification goals correspond to level A1-C1 according to the criteria of the Common European Framework of Reference for Languages (CEFR).A1-A2: The basic use of Italian as a foreign language is taught and practiced on the basis of everyday topics and basic grammatical structures.B1: With an expansion of grammatical knowledge and skills and the development of vocabulary in fields such as everyday working life, culture, business, and current events, the independent use of Italian as a foreign language is taught and practiced.B2: The independent use of Italian as a foreign language is taught and practiced by broadening and deepening previous grammatical knowledge and skills and expanding vocabulary in fields such as everyday work, culture, business, professional specializations, and current events.C1: The independent use of the foreign language Italian is taught and practiced with an extension and deepening of the previous grammatical knowledge and skills and the expansion of the vocabulary in fields such as everyday working life, culture, economics, professional specializations, and current events.Course Objectives and Outcome:Course Objectives and Outcome:A1-A2: Upon successful completion of the course, students can use Italian in everyday situations at level A1-A2 CEFR.B1: Upon successful completion of the course, students can use Italian in everyday situations at B1 CEFR level. Starting at this level, students are able to develop their language skills independently through application and further self-study.B2: Upon successful completion of the course, students will be able to independently use Italian at the B2 CEFR level in most daily and professional situations. They are able to express themselves on a wide range of topics, understand specialist discussions in their own specialist field, and communicate spontaneously and fluently so that a normal conversation with native speakers is possible without great effort. Starting from this level, the students can further develop their language skills with further self-study. C1: Upon successful completion of the course, students will be able to express themselves fluently and spontaneously without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. Students can express themselves in a clear, structured, and detailed way on complex subjects, using various means of text linking appropriately. Starting from this level, the students can further develop their language skills in application and with further self-study.Course Content:The students are able to:Themes: Family (description and introduction of themselves, description and introduction of friends, colleagues and acquaintances); Living (living situation, places of residence); Leisure (shopping, hobbies, traveling, forms of travel, and recreation); Telephoning, reservations, confirmation of orders, feedback; Communication: "Small talk", meetings; Description of their living situation (living, work, and leisure)Grammar: includes past and present tense, sentence construction, and prepositions, etc.Contents of the course A2:The students are able to:Themes everyday life, work, education, studies; work situation, fields of work, places of work, professional goals; personality, description of characteristics; making appointments and agreements; communication: "small talk", talks about places of work, fields of work; description of work situationGrammar: includes imperfect and perfect tenses, the subjunctive, modal verbs, and syntaxContents of the course B1:The students are able to:Thematic: environment: description of places and countries (location, people, places of interest, and special features, etc.); events in business, culture, and politics of immediate importance; use of the foreign language in everyday professional situations; writing: coherent description of places, situations, experiences, recommendations; communication: dialogues, short lecturesGrammar: Training and extension of the applicable sentence tree possibilities (including the subjunctive in various tenses, imperatives, modal verbs, and relative clauses, etc.)Contents of the course B2:The students are able to:Themes: the work day, distribution, sales, communication, human resources, career, solutions for private and business tasksGrammar: includes verb constructions, conditional sentences, and indirect speech, etc.Contents of the course C1:The students are able to:Themes: describe complex issues in detail, link topics with each other, paying special attention to certain aspects, and giving an appropriate conclusionGrammar: includes verb constructions, conditional

Course Outcomes
On successful completion, students will be able to
Contents

Literature
Compulsory Reading
Further Reading
▪ according to the online course Rosetta Stone

Study Format Distance Learning

Study Format Distance Learning	**Course Type**

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study 180 h	**Presence** 0 h	**Tutorial** 60 h	**Self Test** 60 h	**Practical Experience** 0 h	**Hours Total** 300 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

Foreign Language French

Module Code: DLFLF

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N (Foreign Language French)

Contributing Courses to Module
▪ Foreign Language French (DLFLF01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Depending on the CEFR classification, students are qualified to
  - understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves – e.g., where they live, who they know, or what things they have – and answer questions of this kind. They can communicate in a simple way if the other party speaks slowly and clearly and is willing to help. (Level A1)**
  - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, and their local area). They can communicate in simple, routine situations that involve a simple and direct exchange of information about familiar and common things. They can use simple language to describe their own background and education, their immediate environment, and things related to their immediate needs. (level A2)**
  - understand the main points when clear standard language is used and when it comes to familiar matters about work, school, and leisure, etc. They can cope with most situations encountered when traveling in an area where the language is spoken. They can express themselves simply and coherently on familiar topics and personal areas of interest. They can report on experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for their plans and views. (level B1) **
  - understand the main contents of complex texts on concrete and abstract topics and, in their own field, also technical discussions. They can communicate spontaneously and fluently so that a normal conversation with native speakers is possible without much effort. They can express themselves clearly and in detail on a wide range of topics, explain a point of view on a topical issue, and indicate the advantages and disadvantages of different options. (level B2) **
  - understand a wide range of demanding, longer texts and also grasp implicit meanings. They can express themselves spontaneously and fluently without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. They can express themselves in a clear, structured, and detailed manner on complex issues, using various means of text linking appropriately. (level C1)***
- Grammar:
  - Level A1 – includes present and past tenses, sentence construction, and prepositions, etc.
  - Level A2 – includes historical tenses, differences in times of the past, imperative, subordinate clauses, and pronouns (dative, accusative)
  - Level B1 – Among others, an introduction of the pluperfect, conjunctions, the passive, adverbs, adjectives (difference), and the future tense
  - Level B2 – Includes verb constructions, conditional sentences, and indirect speech, etc.
  - Level C1 – Exercises to consolidate and repeat what has been learned
- **Source
  http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp
  and
  http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf
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<table>
<tr><td colspan="2">Learning Outcomes

Foreign Language French

On successful completion, students will be able to</td></tr>
<tr><td>Links to other Modules within the Study Program

This module is similar to other modules in the field of Languages</td><td>Links to other Study Programs of IUBH

All Distance Learning Bachelor Programmes</td></tr>
</table>

Foreign Language French

Course Code: DLFLF01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

The qualification goals correspond to levels A1 through C1, according to the criteria of the Common European Framework of Reference for Languages (CEFR).A1/A2: The basics of French as a foreign language are taught and practiced using everyday topics and simple grammatical structures.B1: Independent use of French as a foreign language is taught, expanding the learner's grammatical knowledge and skills and developing their vocabulary in areas such as everyday working life, culture, business, and current events.B2: Independent use of French as a foreign language is taught and practiced by broadening and deepening previous grammatical knowledge and skills and expanding vocabulary in areas such as everyday work, culture, business, professional specializations, and current events.C1: Independent use of French as a foreign language is taught and practiced with a focus on extending and deepening previous grammatical knowledge and skills and expanding vocabulary in areas such as everyday working life, culture, economics, professional specializations, and current events.Course Objectives and Outcome:A1/A2: Upon successful completion of the course, students can use French in everyday situations at level A1/A2 CEFR.B1: Upon successful completion of the course, students can use French in everyday situations at level B1 CEFR. Starting at this level, students are able to develop their language skills independently through application and further self-study.B2: Upon successful completion of the course, students will be able to independently use French at the level B2 CEFR in most professional situations. They are able to express themselves on a wide range of topics, understand specialist discussions in their own specialist field, and communicate spontaneously and fluently so that a normal conversation with native speakers is possible without great effort. Starting from this level, students can further develop their language skills in application and with further self-study. C1: Upon successful completion of the course, students will be able to express themselves fluently and spontaneously without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. Students can express themselves in a clear, structured, and detailed way on complex subjects, using various means of text linking appropriately. Starting from this level, the students can further develop their language skills in application and with further self-study.Course Content:The students are able to:Themes: Family (description and introduction of themselves, description and introduction of friends, colleagues, and acquaintances); Living (living situation and places of residence); Leisure (shopping, hobbies, traveling, forms of travel, and recreation); Telephoning, reservations, confirmation of orders, and feedback; Communication: "Small talk", meetings; Description of life situation (living, work, and leisure)Grammar: Includes present and past tense, sentence construction, and prepositions, etc.Contents of the course A2:The students are able to:Themes: everyday life, work, education, studies; work situation, fields of work, places of work, professional goals; personality, description of characteristics; making appointments and agreements; communication: "small talk", talks about places of work, fields of work; description of their work.Grammar: among other things, the imperfect and subjunctive tenses, modal verbs, and sentence constructionContents of the course B1:The students are able to:Themes: environment: description of places and countries (location, people, places of interest, and special features, etc.); events in business, culture, and politics of immediate importance; use of the foreign language in everyday professional situations; writing: coherent description of places, situations, experiences, recommendations; communication: dialogues and short lecturesGrammar: Training and extension of the applicable sentence tree possibilities (including the subjunctive in various tenses, the imperative, modal verbs, and relative clauses, etc.)Contents of the course B2:The students are able to:Themes: working day, distribution, sales, communication, human resources, career, solutions for private and business tasksGrammar: includes verb constructions, conditional sentences, and indirect speech, etc.Contents of the course C1:The students are able to:Themes: describe complex issues in detail, link topics with each other, paying special attention to certain aspects and giving an appropriate conclusion.Grammar: includes verb constructions, conditional sentences, and

Course Outcomes
On successful completion, students will be able to
Contents

Literature
Compulsory Reading
Further Reading ▪ according to the online course Rosetta Stone

Study Format Distance Learning

Study Format Distance Learning	Course Type

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

German Language

Module Code: DLSPGLA

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Foreign Language: German)

Contributing Courses to Module

- Foreign Language: German (DLSPGLA01)

Module Exam Type

Module Exam	Split Exam
Study Format: Distance Learning Exam, 180 Minutes	

Weight of Module

see curriculum

Module Contents

Based on general and the use of basic and advanced grammar structures, the students will learn and practice German as a Foreign Language following a CEFRL assessment test.

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

Foreign Language: German

On successful completion, students will be able to
use German as a Foreign Language on the corresponding CEFRL level. The qualifications aimed at correspond to the A1, A2, B1, B2 and C1 levels in accordance with the criteria of the Common European Framework of Reference for Languages (CEFRL).</td></tr>
<tr><td>Links to other Modules within the Study Program

This module is similar to other modules in the field of Languages</td><td>Links to other Study Programs of IUBH

All Distance Learning Bachelor Programmes</td></tr>
</table>

Foreign Language: German

Course Code: DLSPGLA01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description
Depending on the chosen CEFRL level, the students will be enabled to: **A1understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type. Introduce him/herself and others and can ask and answer questions about personal details such as where he/she lives, people he/she knows and things he/she has. Interact in a simple way provided the other person talks slowly and clearly and is prepared to help.A2understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment). Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Describe in simple terms aspects of his/her background, immediate environment and matters in areas of immediate need.B1understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Deal with most situations likely to arise whilst travelling in an area where the language is spoken. Produce simple connected text on topics, which are familiar, or of personal interest. Describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.B2understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialization. Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and Independent disadvantages of various options.C1understand a wide range of sophisticated, longer texts and to grasp implicit meanings. They can express themselves spontaneously and fluently, without having to search for words more clearly. They can use the language effectively and flexibly in their social and professional life or in education and study. They can speak clearly, in a structured manner and in detail about complex issues, using various means of linking text appropriately.**source: http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf and http://www.goethe.de/z/50/commeuro/303.htm

Course Outcomes
On successful completion, students will be able to ▪ use German as a Foreign Language on the corresponding CEFRL level. The qualifications aimed at correspond to the A1, A2, B1, B2 and C1 levels in accordance with the criteria of the Common European Framework of Reference for Languages (CEFRL).

Contents

Literature
Compulsory Reading
Further Reading ▪ Hagner, V./ Schlüter, S. (2013): Im Beruf. Deutsch als Fremd- und Zweitsprache. Hueber Verlag, München. ▪ Perlmann-Balme, M./ Schwalb, S./ Matussek, Magdalena (2013): Sicher! B2/1. Deutsch als Fremdsprache. Hueber Verlag, München. ▪ Eismann, Volker (2006): Training berufliche Kommunikation. B2-C1 - Erfolgreich bei Präsentationen. Kursbuch mit CD Taschenbuch. Cornelsen Verlag, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

Foreign Language Spanish

Module Code: DLFLS

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
see curriculum	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language Spanish)

Contributing Courses to Module
▪ Foreign Language Spanish (DLFLS01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Depending on the CEFR classification, students will be able to
  - understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g., where they live, who they know, or what things they have - and provide answers to these kinds of questions. They can communicate in a simple way if the other party speaks slowly and clearly and is willing to help (Level A1).**
  - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. personal and family information, shopping, work, and their local area). They can communicate in simple, routine situations that involve a simple and direct exchange of information about familiar and common things. They can use simple language to describe their own background and education, their immediate environment, and things related to their immediate needs (Level A2)**
  - understand the main points when clear standard language is used and when it comes to familiar matters about work, school, leisure, etc. They can cope with most situations encountered when travelling in an area where the language is spoken. They can express themselves simply and coherently on familiar topics and personal areas of interest. They can report on experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for their plans and views. (Level B1) **
  - understand the main content of complex texts on concrete and abstract topics and, in their own field, also technical discussions. They can communicate spontaneously and fluently so that a normal conversation with native speakers is possible without much mutual effort. They can express themselves clearly and in detail on a wide range of topics, explain a point of view on a topical issue, and indicate the advantages and disadvantages of different options. (Level B2) **
  - understand a wide range of demanding, longer texts and also grasp implicit meanings. They can express themselves spontaneously and fluently without having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. They can express themselves in a clear, structured, and detailed manner on complex issues, using various means of text linking appropriately. (level C1)***
- Grammar:
  - Level A1 - Includes present and past tenses, sentence construction, and prepositions, etc.
  - Level A2 - Includes historical tenses, differences in times of the past, imperative, subordinate clauses, and pronouns (dative, accusative)
  - Level B1 - Among others, introduces the pluperfect, conjunctions, the passive, adverbs, adjectives (difference), and the future tense
  - Level B2 - Includes verb constructions, conditional sentences, and indirect speech, etc.
  - Level C1 – Includes exercises to consolidate and repeat what has been learned
- **Source
  http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp
  and
  http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf
- ***Source
  http://www.goethe.de/z/50/commeuro/303.htm=- sync:ßÇÈâÈâ

Learning Outcomes	
Foreign Language Spanish On successful completion, students will be able to	
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 IUBH** All Distance Learning Bachelor Programmes

Foreign Language Spanish

Course Code: DLFLS01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

Study goals correspond to the language levels A1-C1, as specified in the Common European Framework of Reference for Languages (CEFR).A1-A2: The basic use of Spanish as a foreign language is taught and practiced on the basis of everyday topics and basic grammatical structures.B1: With an expansion of grammatical knowledge and skills and the development of vocabulary in fields such as everyday working life, culture, business and current events, the independent use of Spanish is taught and practiced.B2: The independent use of Spanish is taught and practiced with an extension and deepening of the previous grammatical knowledge and skills and the expansion of the vocabulary in fields such as everyday working life, culture, economics, professional specializations, and current events.C1: The independent use of Spanish is taught and practiced with an extension and deepening of the previous grammatical knowledge and skills and the expansion of the vocabulary in fields such as everyday working life, culture, economics, professional specializations, and current events.Course Objectives and Outcome:Course Objectives and Outcome:A1-A2: Upon successful completion of the course, students can use Spanish in everyday situations at level A1-A2 CEFR.B1: Upon successful completion of the course, students can use Spanish in everyday situations at B1 CEFR level. Starting at this level, students are able to develop their language skills independently through application and further self-study.B2: Upon successful completion of the course, students will be able to independently use Spanish at the B2 CEFR level in most daily and professional situations. They are able to express themselves on a wide range of topics in order to understand specialist discussions in their own specialist field, and to communicate spontaneously and fluently so that a normal conversation with native speakers is possible without great effort being made by either side. Starting from this level, students can further develop their language with further self-study.C1: Upon successful completion of the course, students will be able to express themselves fluently and spontaneously without having to search for words often. They can use the language effectively and flexibly in social and professional life or in training and studies. Students can express themselves in a clear, structured and detailed way on complex subjects, using various means of text linking appropriately. Starting from this level, the students can further develop their language skills with further self-study.Course Content:The students are able to:Themes: Family (description and introduction of themselves, description and introduction of friends, colleagues, and acquaintances); Living (living situation, places of residence); Leisure (shopping, hobbies, travelling, forms of travel, and recreation); Telephoning, reservation, confirmation of order, feedback; Communication: "Small talk", meetings; Description of daily life (living, work, and leisure)Grammar: includes present and past tense, sentence construction, and prepositions, etc.Contents of the course A2:The students are able to:Themes: everyday life, work, education, and studies; work situation, fields of work, places of work, professional goals; personality and description of characteristics; making appointments and agreements; communication: "small talk", talking about places of work, fields of work, describing their work situation.Grammar: includes the perfect and imperfect tenses, the subjunctive, modal verbs, and sentence structureContents of the course B1:The students are able to:Themes: environment: description of places and countries (location, people, places of interest, and special features, etc.); events in business, culture, and politics of immediate importance; use of the foreign language in everyday professional situations; writing: coherent description of places, situations, experiences, recommendations; communication: dialogues and short lectures.Grammar: Training and extension of the applicable sentence tree possibilities (including subjunctive in various tenses, imperative, modal verbs, and relative clauses, etc.)Contents of the course B2:The students are able to:Themes: working day, distribution, sales, communication, human resources, career, solutions for private and business tasksGrammar: includes verb constructions, conditional sentences, and indirect speech, etc.Contents of the course C1:The students are able to: Thematically: describe complex issues in detail, link topics with each other, paying special attention to certain aspects and giving an appropriate conclusionGrammar: including verb

Course Outcomes
On successful completion, students will be able to
Contents

Literature
Compulsory Reading
Further Reading ▪ according to the online course Rosetta Stone

Study Format Distance Learning

Study Format	Course Type
Distance Learning	

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

Foreign Language Turkish

Module Code: DLFLT

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language Turkish)

Contributing Courses to Module
▪ Foreign Language Turkish (DLFLT01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents
▪ Depending on the acquired CEFR level, students are enabled to ▪ understand and use familiar, everyday expressions and very simple sentences aimed at the fulfilment of fundamental needs. Students can introduce themselves and others, ask and answer questions about themselves and others, such as where they live, people they know and things they own. 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) ** ▪ understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. personal and family information, shopping, work, accustomed settings). Students can communicate in simple, familiar situations involving a basic and direct exchange of information on habitual and predictable issues. They can describe their own background and education, their immediate environment and things related to immediate needs in simple expressions. (Level A2) ▪ Grammar: ▪ Level A1 - among other things tenses of the present and past, sentence structure ▪ Level A2 – among other things tenses of the past, differences in past tenses, imperative, subordinate clauses, pronouns ▪ **Source http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp and http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf ▪ *** Source: http://www.goethe.de/z/50/commeuro/303.htm

Learning Outcomes
Foreign Language Turkish On successful completion, students will be able to

Links to other Modules within the Study Program	**Links to other Study Programs of IUBH**
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Foreign Language Turkish

Course Code: DLFLT01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

Description of the course:The qualification objectives correspond to levels A1-A2 following the criteria of the Common European Framework of Reference for Languages (CEFR).A1-A2: The elementary use of the foreign language Turkish is taught and practiced on the basis of everyday topics and using elementary grammatical structures.Course objectives:A1-A2: After successful completion of the course, students can use Turkish in everyday situations at the A1 CEFR level.Contents of the course A1:Students are enabled to,Thematic: family (description and introduction of oneself, description and introduction of friends, colleagues and acquaintances); residence (living situation, places of residence); leisure time (shopping, hobbies, travelling, forms of travel, recreation); telephoning, reservations, order confirmation, feedback; communication: "small talk", getting to know each other; description of life situation (living, work, leisure time)Grammar: among other things tenses of the present and past, sentence structureContents of the course A2:Students are enabled to,Thematic: everyday life, work, training, studies; work situation, fields of work, places of work, professional goals; personality, description of character traits; making appointments and agreements; communication: "small talk", conversations about places of work, fields of work; description of the working environmentGrammar: among other things, tenses of the past, sentence structure

Course Outcomes

On successful completion, students will be able to

Contents

Literature

Compulsory Reading

Further Reading

- according to information in the online course Rosetta Stone

Study Format Distance Learning

Study Format Distance Learning	Course Type Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Handling Technology) / N.N. (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 (50) Automation Technology • Study Format "Distance Learning": Exam (50)
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 IUBH
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	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

- Haun, M. (2013): Handbuch Robotik. Programmieren und Einsatz intelligenter Roboter. 2. Auflage, Springer Vieweg Verlag, Berlin.
- Hesse, S. (2016): Grundlagen der Handhabungstechnik. 4., überarbeitete und erweiterte Auflage, Carl Hanser Verlag, München.
- Hesse, S. (2016): Taschenbuch. Robotik - Montage – Handhabung. 2., neu bearbeitete Auflage, Carl Hanser Verlag, München.
- Maier, H. (2016): Grundlagen der Robotik. VDE Verlag GmbH, Berlin.
- Wolf, A./Schunk, H. (2016): Greifer in Bewegung. Faszination der Automatisierung von Handhabungsaufgaben. 2. Auflage, Carl Hanser Verlag, München.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

Automation Technology

Course Code: DLBROEIRA02_E

Study Level	Language of Instruction	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

- Gupta, A. K./Arora, S. K./Westcott, J. R. (2016): Industrial automation and robotics. Mercury Learning & Information, Herndon, VA.
- Mehta, B. R./Reddy, Y. J. (2014): Industrial process automation systems: Design and implementation. Elsevier Inc, Amsterdam.
- Merz, H./Hansemann, T./Hübner, C. (2018): Building Automation. Springer International Publishing, Cham.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Mobile Robotics) / N.N. (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": Module Exam (50) Soft Robotics • Study Format "Distance Learning": Exam (50)
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 IUBH
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	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
   - 2.3 Mobile Robot Maneuverability
   - 2.4 Mobile Robot Workspace
   - 2.5 Applications

3. Dynamics
   - 3.1 Basics
   - 3.2 Dynamic Modeling
   - 3.3 Examples

4. Perception
   - 4.1 Sensors for Mobile Robots
   - 4.2 Position and Velocity Sensors
   - 4.3 Accelerometers
   - 4.4 Inertial Measurement Unit
   - 4.5 Distance Sensors
   - 4.6 Vision Sensors
   - 4.7 Robot Vision and Image Processing
   - 4.8 Global Positioning System

5. Mobile Manipulators
   - 5.1 Basics
   - 5.2 Modeling
   - 5.3 Examples

6. Path, Motion and Task Planning
   - 6.1 Basics
   - 6.2 Path Planning
   - 6.3 Motion Planning
   - 6.4 Task Planning

7. Localization and Mapping
   - 7.1 Sensor Imperfections
   - 7.2 Relative Localization
   - 7.3 Absolute Localization
   - 7.4 Localization, Calibration and Sensor Fusion
   - 7.5 Simultaneous Localization and Mapping
   - 7.6 Examples

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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Module Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

Soft Robotics

Course Code: DLBROESR02_E

Study Level	Language of Instruction	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 Materials and Properties of Soft Actuators
   - 2.2 Thermo-driven Soft Actuators
   - 2.3 Electro-driven Soft Actuators
   - 2.4 Light-driven Soft Actuators
   - 2.5 Magneto-driven Soft Actuators
   - 2.6 Pneumatic Actuators
   - 2.7 Examples

3. Sensors
   - 3.1 Basics
   - 3.2 Proximity Sensing
   - 3.3 Mechano-sensing
   - 3.4 Examples

4. Modeling
   - 4.1 Artificial Muscles
   - 4.2 Interactions
   - 4.3 Compliance Control
   - 4.4 Variable-stiffness Actuators

5. Applications
   - 5.1 Soft Bionic Hands
   - 5.2 Healthcare and Surgery
   - 5.3 Underwater and Aquatic Propulsion
   - 5.4 Bio-inspired Aerial Robots

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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

DLBROESR02_E

Introduction to Cognitive Robotics

Module Code: DLBROEICR_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Digital Signal Processing) / N.N. (Fundamentals of NLP and Computer Vision)

Contributing Courses to Module
▪ Digital Signal Processing (DLBROEICR01_E) ▪ Fundamentals of NLP and Computer Vision (DLBROEICR02_E)

Module Exam Type	
Module Exam	**Split Exam** Digital Signal Processing • Study Format "Distance Learning": Exam, 90 Minutes (50) Fundamentals of NLP and Computer Vision • Study Format "Distance Learning": Exam, 90 Minutes (50)
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 **Fundamentals of NLP and Computer Vision** ▪ Introduction to Natural Language Processing ▪ Introduction to Computer Vision ▪ Applications to Robotics

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. **Fundamentals of NLP and Computer Vision** On successful completion, students will be able to ▪ name central problems and challenges in natural language processing and computer vision. ▪ understand common methods used in natural language processing and computer vision. ▪ name common use-case scenarios in which NLP and computer vision techniques are applied. ▪ design basic language processing and computer vision solutions for use in robotics.

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

Digital Signal Processing

Course Code: DLBROEICR01_E

Study Level	Language of Instruction	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
   - 3.1 Digital Signals
   - 3.2 Difference Equations and Impulse Responses
   - 3.3 BIBO-Stability
   - 3.4 Digital Convolution

4. Discrete Fourier Transform
   - 4.1 Discrete Fourier Transform
   - 4.2 Amplitude and Power Spectrum
   - 4.3 Spectral Estimation

5. The z-Transform
   - 5.1 Definition
   - 5.2 Properties
   - 5.3 Inverse z-Transform
   - 5.4 Solution of Difference Equations

6. Digital Signal Processing Systems and Filters
   - 6.1 Difference Equation and Transfer Function
   - 6.2 Poles, Zeros and Stability
   - 6.3 Digital Filter Frequency Response
   - 6.4 Basic Filtering
   - 6.5 Realization of Digital Filters
   - 6.6 Applications

7. Finite Impulse Response Filter Design
   - 7.1 Basics
   - 7.2 Fourier Transform Design
   - 7.3 Window Method
   - 7.4 Frequency Sampling Design Method
   - 7.5 Optimal Design Method
   - 7.6 Applications

8. Infinite Impulse Response Filter Design
    - 8.1 Basics
    - 8.2 Bilinear Transformation Design Method
    - 8.3 Butterworth and Chebyschev Filter Designs
    - 8.4 Higher-Order Infinite Impulse Response Filter Design
    - 8.5 Pole-Zero Placement for Simple Filters
    - 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Fundamentals of NLP and Computer Vision

Course Code: DLBROEICR02_E

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

Course Description

Innovative robots, belonging to the so-called generation 3.0, need to sense and understand the environment in many ways, for instance using vision and language understanding and processing. This course introduces the topics of natural language processing (NLP) and computer vision, discussing the main techniques of both fields as well as their application in the field of robotics.

Course Outcomes

On successful completion, students will be able to

- name central problems and challenges in natural language processing and computer vision.
- understand common methods used in natural language processing and computer vision.
- name common use-case scenarios in which NLP and computer vision techniques are applied.
- design basic language processing and computer vision solutions for use in robotics.

Contents

1. Introduction to NLP
   - 1.1 History
   - 1.2 Basics Concepts of NLP
   - 1.3 Feature Extraction Methods

2. Applications of NLP
   - 2.1 Topic Modeling
   - 2.2 Text Summarization and Generation
   - 2.3 Sentiment Analysis
   - 2.4 Translation
   - 2.5 Chatbots

3. Introduction to Computer Vision
   - 3.1 Light and Color
   - 3.2 Image Formation
   - 3.3 Image Processing
   - 3.4 Image Feature Extraction
   - 3.5 Stereo Vision

4. Applications of Computer Vision
   - 4.1 Image Classification, Motion Tracking
   - 4.2 Semantic Segmentation
   - 4.3 Object Identification and Tracking
   - 4.4 Eigenfaces and Facial Recognition

5. NLP and Computer Vision in Robotics
   - 5.1 Camera Calibration
   - 5.2 Pose Estimation
   - 5.3 Visual Servoing
   - 5.4 Human-Robot Interaction
   - 5.5 Privacy Issues

Literature

Compulsory Reading

Further Reading

- Bird S., Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O'Reilly, Sebastopol, CA.
- Fisher, R. B., et al (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ.
- Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

DLBROEICR02_E

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Ulrich Kerzel (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 "Distance Learning": Exam, 90 Minutes Project: Artificial Intelligence • Study Format "Fernstudium": Portfolio
Weight of Module see curriculum	

Module Contents
Artificial Intelligence ▪ 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** ▪ 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.

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.

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

Artificial Intelligence

Course Code: DLBDSEAIS01

Study Level	Language of Instruction	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 Pixels and filters
   - 5.2 Feature detection
   - 5.3 Distortions and calibration
   - 5.4 Semantic segmentation

Literature

Compulsory Reading

Further Reading

- Bear, F./Barry, W./Paradiso, M. (2006): Neuroscience: Exploring the brain. 3rd ed., Lippincott Williams and Wilkins, Baltimore, MD:
- Bird S./Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O'Reilly, Sebastopol, CA.
- Chollet, F. (2017): Deep learning with Python. Manning, Shelter Island, NY.
- Fisher, R. B., et al. (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- Geron, A. (2017): 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.
- Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ.
- Nilsson, N. (2009): The quest for artificial intelligence. Cambridge University Press, Cambridge.
- Russell, S./Norvig, P. (2009): Artificial intelligence: A modern approach. 3rd ed., Pearson, Essex.
- Sutton, R./Barto, A. (2018): Reinforcement learning: An introduction. 2nd ed., MIT Press, Boston, MA.
- Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden.
- Szepesvári, C. (2010): Algorithms for reinforcement learning. Morgan & Claypool, San Rafael, CA.
- Wiering, M./Otterlo, M. (2012): Reinforcement learning: State of the art. Springer, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☑ Live Tutorium/Course Feed

Project: Artificial Intelligence

Course Code: DLBDSEAIS02

Study Level	Language of Instruction	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. (2006): Neuroscience: Exploring the brain. 3rd ed., Lippincott Williams and Wilkins, Baltimore, MD: ▪ Bird S./Klein, E./Loper, E. (2009): Natural language processing with Python. 2nd ed., O'Reilly, Sebastopol, CA. ▪ Chollet, F. (2017): Deep learning with Python. Manning, Shelter Island, NY. ▪ Fisher, R. B., et al. (2016) : Dictionary of computer vision and image processing. John Wiley & Sons, Chichester. ▪ Geron, A. (2017): 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. ▪ Jurafsky, D./Martin, J. H. (2008): Speech and language processing. Prentice Hall, Upper Saddle River, NJ. ▪ Nilsson, N. (2009): The quest for artificial intelligence. Cambridge University Press, Cambridge. ▪ Russell, S./Norvig, P. (2009): Artificial intelligence: A modern approach. 3rd ed., Pearson, Essex. ▪ Sutton, R./Barto, A. (2018): Reinforcement learning: An introduction. 2nd ed., MIT Press, Boston, MA. ▪ Szelski, R. (2011): Computer vision: Algorithms and applications. 2nd ed., Springer VS, Wiesbaden. ▪ Szepesvári, C. (2010): Algorithms for reinforcement learning. Morgan & Claypool, San Rafael, CA. ▪ Wiering, M./Otterlo, M. (2012): Reinforcement learning: State of the art. Springer, Berlin.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Self-Driving Vehicles) / N.N. (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 "Distance Learning": Exam, 90 Minutes (50) <u>Seminar: Current Topics and Trends in Self-Driving Technology</u> • Study Format "Distance Learning": Written Assessment: Research Essay (50)
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 IUBH
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	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 calibaration
   - 1.4 Application scenarios
2. Sensor Fusion
   - 2.1 Elaborating data from sensors
   - 2.2 Kalman filter
   - 2.3 Object tracking

3. Computer Vision
   - 3.1 Pixels and filters
   - 3.2 Feature detection
   - 3.3 Distortions and calibration
   - 3.4 Semantic segmentation

4. Localization & Motion
   - 4.1 Motion models
   - 4.2 Odometry
   - 4.3 Triangulation
   - 4.4 Satellite-based localization

5. Motion planning
   - 5.1 Path planning
   - 5.2 Motion prediction
   - 5.3 Trajectory generation

6. Safety Standards
   - 6.1 Functional Safety
   - 6.2 IT Security Standards
   - 6.3 Safety development approaches

Literature
Compulsory Reading

Further Reading

- Ben-Ari, M./Mondada, F. (2018): Elements of robotics. Springer, Cham.
- European Union. (2001).:Directive 2001/95/EG. (URL: https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32001L0095 [Retrieved: 28.02.2020])
- Fisher, R. B., et al. (2016): Dictionary of computer vision and image processing. John Wiley & Sons, Chichester.
- International Electrotechnical Commission. (2015): IEC 61508. (URL: https://www.iec.ch/functionalsafety/ [Retrieved: 28.02.2020])
- International Organization for Standardization. (2009): ISO 15408. (URL: https://www.iso.org/standard/50341.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (2018): ISO 25119. (URL: https://www.iso.org/standard/69026.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (2018): ISO 26262. (URL: https://www.iso.org/standard/68383.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (n.d.): ISO 21434. (URL: https://www.iso.org/standard/70918.html [Retrieved: 28.02.2020])
- International Organization for Standardization. (2018): ISO/IEC 27001. (URL: https://www.iso.org/isoiec-27001-information-security.html [Retrieved: 28.02.2020])
- Rausand, M. (2014): Reliability of safety-critical systems: Theory and applications. Wiley, Hoboken, NJ.
- 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. (URL: https://www.sae.org/standards/content/j3061/ [Retrieved: 28.02.2020])
- Szelski, R. (2011): 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

Seminar: Current Topics and Trends in Self-Driving Technology

Course Code: DLBDSEAD02

Study Level	Language of Instruction	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. (URL: https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32001L0095 [Retrieved: 28.02.2020]) ▪ Fisher, R. B., et al. (2016): Dictionary of computer vision and image processing. John Wiley & Sons, Chichester. ▪ International Electrotechnical Commission. (2015): IEC 61508. (URL: https://www.iec.ch/functionalsafety/ [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2009): ISO 15408. (URL: https://www.iso.org/standard/50341.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2018): ISO 25119. (URL: https://www.iso.org/standard/69026.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2018): ISO 26262. (URL: https://www.iso.org/standard/68383.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (n.d.): ISO 21434. (URL: https://www.iso.org/standard/70918.html [Retrieved: 28.02.2020]) ▪ International Organization for Standardization. (2018): ISO/IEC 27001. (URL: https://www.iso.org/isoiec-27001-information-security.html [Retrieved: 28.02.2020]) ▪ Marchthaler, R./Dingler, S. (2017): Kalman-Filter. Springer, Wiesbaden. ▪ Rausand, M. (2014): Reliability of safety-critical systems: Theory and applications. Wiley, Hoboken, NJ. ▪ 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. (URL: https://www.sae.org/standards/content/j3061/ [Retrieved: 28.02.2020]) ▪ Szelski, R. (2011): 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	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Research Essay

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☑ Live Tutorium/Course Feed

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator

N.N. (Data Analytics and Big Data) / N.N. (Deep Learning)

Contributing Courses to Module

- Data Analytics and Big Data (DLBINGDABD01_E)
- Deep Learning (DLBDBDL01_E)

Module Exam Type	
Module Exam	**Split Exam** Data Analytics and Big Data • Study Format "Distance Learning": Written Assessment: Case Study Deep Learning • 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 IUBH**
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	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
   - 1.5 Internet of Things as Driver for Big Data

2. Statistical Basics
   - 2.1 Descriptive Data Analysis
   - 2.2 Inferential Data Analysis
   - 2.3 Explorative Data Analysis
   - 2.4 Multivariate Data Analysis

3. Data Mining
   - 3.1 Knowledge Discovery in Databases
   - 3.2 Association Analysis
   - 3.3 Correlation Analysis
   - 3.4 Forecast
   - 3.5 Cluster Analysis
   - 3.6 Classification

4. Big Data Methods and Technologies
   - 4.1 Technology Building Blocks
   - 4.2 MapReduce
   - 4.3 Text- and Semantic Analysis
   - 4.4 Audio and Video Analysis
   - 4.5 BASE and NoSQL
   - 4.6 In-Memory Databases
   - 4.7 Big Data Success Factors

5. Legal Aspects of Data Analysis
   - 5.1 Data Protection Principles in Germany
   - 5.2 Anonymization and Pseudonymization
   - 5.3 International Data Analysis
   - 5.4 Performance and Integrity Protection

6. Solution Scenarios

7. Application of Big Data in the Industry
   - 7.1 Production and Logistics
   - 7.2 Increased Efficiency in the Supply Chain
   - 7.3 Key-Factor Data
   - 7.4 Examples and Conclusion

Literature
Compulsory Reading
Further Reading ▪ Brandt, S. (2013): Datenanalyse für Naturwissenschaftler und Ingenieure. Mit statistischen Methoden und Java-Programmen. 5. Auflage, Springer, Wiesbaden. ▪ Dorschel, J. (Hrsg.) (2015): Praxishandbuch Big Data. Wirtschaft – Recht – Technik. Springer Gabler Wiesbaden. ▪ Gandomi, A./Haider, M. (2015): Beyond the hype. Big data concepts, methods, and analytics. In: International Journal of Information Management, 35. Jg., Heft 2, S. 137–144. ▪ Provost, F./Fawcett, T. (2013): Data science for business. What You Need to Know About Data Mining and Data-Aalytic Thinking. O'Reilly, Sebastopol (CA). ▪ Runkler, T. A. (2015): Data Mining. Modelle und Algorithmen intelligenter Datenanalyse. 2. Auflage, Springer Vieweg, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Case Study

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Written Assessment: Case Study

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
110 h	0 h	20 h	20 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☑ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☑ Live Tutorium/Course Feed

Deep Learning

Course Code: DLBDBDL01_E

Study Level	Language of Instruction	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
   - 2.4 Types of 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	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

DLBDBDL01_E

Python for Software Engineering

Module Code: DLBROEPSE_E

Module Type	Admission Requirements	Study Level	CP	Student Workload
see curriculum	▪ DLBDSIPWP01 or DLBDSIPWP01_D; DLBDSOOFPP01 or IOBP01 ▪ none	BA	10	300 h

Semester / Term	Duration	Regularly offered in	Language of Instruction
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 (50) Data Science Software Engineering • Study Format "Distance Learning": Exam, 90 Minutes (100)
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 IUBH
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	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, Sebastopol, CA. ▪ 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, Birmingham. ▪ Ramalho, L. (2015): Fluent Python: Clear, concise, and effective programming. O'Reilly, Sebastopol, CA.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Portfolio

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☑ Live Tutorium/Course Feed

Data Science Software Engineering

Course Code: DLBDSDSSE01

Study Level	Language of Instruction	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

- Farcic, V. (2016): The DevOps 2.0 toolkit: Automating the continuous deployment pipeline with containerized microservices. CreateSpace Independent Publishing Platform, Scotts Valley, CA.
- Humble, J./Farley, D. (2010): Continuous delivery: Reliable software releases through build, test, and deployment automation. Addison-Wesley Professional, Boston, MA.
- Humble, J./Molesky, J./O'Reilly, B. (2015): Lean enterprise. O'Reilley Publishing, Sebastopol, CA.
- Hunt, A./Thomas, D. (1999): The pragmatic programmer. From journeyman to master. Addison-Wesley, Reading, MA.
- Martin, R. C. (2008): Clean code. Prentice Hall, Boston, MA.
- Morris, K. (2016): Infrastructure as code. O'Reilley Publishing, Sebastopol, CA.
- Richardson, L./Ruby, S. (2007): RESTful web services. O'Reilley Publishing, Sebastopol, CA.
- Senge, P. (1990): The fifth discipline: The art and practice of the learning organization. Broadway Business, New York, NY.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☑ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

IT Security

Module Code: DLBROEITS_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
Prof. Dr. Ralf Kneuper (Introduction to Data Protection and Cyber Security) / N.N. (Cryptography)

Contributing Courses to Module
▪ Introduction to Data Protection and Cyber Security (DLBCSIDPITS01) ▪ Cryptography (DLBCSCT01)

Module Exam Type	
Module Exam	**Split Exam** Introduction to Data Protection and Cyber Security • Study Format "Distance Learning": Exam, 90 Minutes Cryptography • Study Format "Distance Learning": Exam, 90 Minutes
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 IUBH
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	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

- Eckert, C. (2014): IT-Sicherheit. Konzepte – Verfahren – Protokolle. 9. Auflage, De Gruyter, München.
- Poguntke, W. (2013): Basiswissen IT-Sicherheit. Das Wichtigste für den Schutz von Systemen & Daten. 3. Auflage, W3l, Dortmund.
- Witt, B. C. (2010): Datenschutz kompakt und verständlich. 2. Auflage, Vieweg+Teubner, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☑ Course Book	☐ Creative Lab
☐ Vodcast	☐ Guideline
☑ Shortcast	☐ Live Tutorium/Course Feed
☑ Audio	
☑ Exam Template	

Cryptography

Course Code: DLBCSCT01

Study Level	Language of Instruction	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
   - 3.3 Message Authentication Code
   - 3.4 Steganographic Methods
4. Authentication
   - 4.1 Passwords and Public-Key-Certificates
   - 4.2 Challenge-Response-Procedure and Zero-Knowledge-Procedure
   - 4.3 Biometric Methods
   - 4.4 Authentication in Distributed Systems
   - 4.5 Identities Through Smartcards
5. Security of Single Computers
   - 5.1 Malware and Cookies
   - 5.2 Some Special Features of Operating Systems
   - 5.3 Web Server Security
6. Security in Communication Networks
   - 6.1 Security Problems and Defense Concepts
   - 6.2 Internet Standards for Communication Security
   - 6.3 Identity and Anonymity
   - 6.4 Security in Mobile and Wireless Communications
7. Security in E-Commerce
   - 7.1 Email Security
   - 7.2 Online Banking and Online Payments
   - 7.3 Electronic Money
8. Secure Software Development
   - 8.1 Threat Modeling
   - 8.2 Secure Software Design
   - 8.3 Techniques for Safe Programming

Literature
Compulsory Reading
Further Reading ▪ Baumann, U./Franz, E./Pfitzmann, A. (2014): Kryptographische Systeme. Springer Vieweg, Wiesbaden. ▪ Beutelspacher, A. (2014): Kryptologie. Eine Einführung in die Wissenschaft vom Verschlüsseln, Verbergen und Verheimlichen. 10. Auflage, Springer Spektrum, Wiesbaden. ▪ Eckert, C. (2014): IT-Sicherheit. Konzepte – Verfahren – Protokolle. 9. Auflage, De Gruyter Oldenbourg, München. ▪ Ertel, W. (2010): Angewandte Kryptographie. 4. Auflage, Hanser, München. ▪ Spitz, S./Pramateftakis, M./Swoboda, J. (2011): Kryptographie und IT-Sicherheit. Grundlagen und Anwendungen. 2. Auflage, Vieweg+Teubner; Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☑ Course Book
- ☐ Vodcast
- ☑ Shortcast
- ☐ Audio
- ☑ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☐ Guideline
- ☐ Live Tutorium/Course Feed

Mobile Software Engineering

Module Code: IWMB_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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Mobile Software Engineering) / N.N. (Project: Mobile Software Engineering)

Contributing Courses to Module
▪ Mobile Software Engineering (IWMB01_E) ▪ Project: Mobile Software Engineering (IWMB02_E)

Module Exam Type	
Module Exam	**Split Exam** Mobile Software Engineering • Study Format "Distance Learning": Exam, 90 Minutes (50) Project: Mobile Software Engineering • Study Format "Fernstudium": Written Assessment: Project Report (49)
Weight of Module see curriculum	

Module Contents	
Mobile Software Engineering ▪ Basics of Mobile Software Development ▪ Android System Architecture ▪ Programming Environment ▪ Core Components of Android Apps ▪ Interaction between Application Components ▪ Advanced Methods **Project: Mobile Software Engineering** Design, implementation and documentation of small, mobile applications based on a specific example.	
Learning Outcomes **Mobile Software Engineering** On successful completion, students will be able to ▪ recognize and describe the variances and specific features of software development for mobile systems. ▪ distinguish between different activities, parts and risks in the creation, operation and maintenance of mobile software systems . ▪ explain and differentiate the architecture and technical features of the Android Platform. ▪ autonomously create mobile software systems to solve concrete problems for the Android Platform . **Project: Mobile Software Engineering** On successful completion, students will be able to ▪ autonomously design and prototype small mobile applications to solve a specific task. ▪ identify typical problems and challenges in the practical implementation of small mobile applications. ▪ document the creation and implementation of small, autonomously 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	**Links to other Study Programs of IUBH** All Bachelor Programmes in the IT & Technology fields

Mobile Software Engineering

Course Code: IWMB01_E

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

Course Description

Using the mobile platform Android as an example, the course explains how the programming of mobile applications (Apps) differs from the development of browser-based information systems, gives an overview of technologies and programming concepts deployed and describes common challenges in the development of apps for industrial applications.

Course Outcomes

On successful completion, students will be able to

- recognize and describe the variances and specific features of software development for mobile systems.
- distinguish between different activities, parts and risks in the creation, operation and maintenance of mobile software systems .
- explain and differentiate the architecture and technical features of the Android Platform.
- autonomously 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 Security Features
   - 2.3 Communication with Networks
3. Programming Environment
   - 3.1 Android Studio
   - 3.2 First App and Emulator Test
   - 3.3 Application Deployment

4. Core Components of Android Apps
   - 4.1 Overview of Android App Components
   - 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 Receive

6. Advanced Methods
   - 6.1 Threading
   - 6.2 Application memory

Literature

Compulsory Reading

Further Reading

- Eason, J. (2014): Android Studio 1.0. (URL: https://android-developers.googleblog.com/2014/12/android-studio-10.html [letzter Zugriff: 12.06.2015]).
- Google Inc. (Hrsg.) (2015): Android Developer Guide. (URL: http://developer.android.com/guide)
- Google Inc. (Hrsg.) (2015): App Components. (URL: http://developer.android.com/guide/components/index.html [letzter Zugriff: 12.06.2015]).
- Google Inc. (Hrsg.) (2015): Installing the Android SDK. (URL: http://developer.android.com/sdk/installing/index.html [letzter Zugriff: 13.05.2015]).
- Google Inc. (Hrsg.) (2015): Resources Overview. (URL: http://developer.android.com/guide/topics/resources/overview.html [letzter Zugriff: 12.06.2015]).
- Hipp, Wyrick & Company, Inc. (Hrsg.) (2015): SQLite Webseite. (URL: http://sqlite.org/index.html [letzter Zugriff: 12.06.2015]).

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** yes **Course Evaluation:** no
Type of Exam	Exam, 90 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
90 h	0 h	30 h	30 h	0 h	150 h

Instructional Methods	
☐ Learning Sprints® ☑ Course Book ☐ Vodcast ☑ Shortcast ☑ Audio ☑ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Project: Mobile Software Engineering

Course Code: IWMB02_E

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

Course Description

With the material conveyed in the course "Mobile Software Engineering Using the Android Platform as an Example", students autonomously create a mobile application and document its design and implementation.

Course Outcomes

On successful completion, students will be able to

- autonomously design and prototype small mobile applications to solve a specific task.
- identify typical problems and challenges in the practical implementation of small mobile applications.
- document the creation and implementation of small, autonomously designed and implemented mobile applications .

Contents

- Design, implementation and documentation of small, mobile applications based on a specific example. Possible topics are, for example:
  - A radio app to improve the exchange between listeners and station in general, and particularly between listeners and radio presenters.
  - An app that allows a group of board game fans to better organize their regular evening game schedule.
  - An app that enables the supervisors of assignments at IUBH to improve their support procedures.

Literature
Compulsory Reading
Further Reading ▪ Becker, A./Pant, M. (2015): Android 5. Programmieren für Smartphones und Tablets. 4. Auflage, dpunkt, Heidelberg. ▪ Eason, J. (2014): Android Studio 1.0. (URL: http://android-developers.blogspot.de/2014/12/android- studio-10.html [letzter Zugriff: 12.06.2015]). ▪ Franke, F./Ippen, J. (2012): Apps mit HTML5 und CSS3. Rheinwerk Verlag, Bonn. ▪ Google Inc. (Hrsg.) (2015): Android Developer Guide. (URL: http://developer.android.com/guide) ▪ Google Inc. (Hrsg.) (2015a): App Components. (URL: http://developer.android.com/guide/components/ index.html [letzter Zugriff: 12.06.2015]). ▪ Google Inc. (Hrsg.) (2015b): Installing the Android SDK. (URL: http://developer.android.com/sdk/ installing/index.html [letzter Zugriff: 13.05.2015]). ▪ Google Inc. (Hrsg.) (2015c): Resources Overview. (URL: http://developer.android.com/guide/topics/ resources/overview.html [letzter Zugriff: 12.06.2015]). ▪ Hipp, Wyrick & Company, Inc. (Hrsg.) (2015): SQLite Webseite. (URL: http://sqlite.org/index.html [letzter Zugriff: 12.06.2015]). ▪ Künneth, T. (2016): Android 7. Das Praxisbuch für Entwickler. 4. Auflage, Rheinwerk, Bonn.

Study Format Fernstudium

Study Format	Course Type
Fernstudium	Project

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Written Assessment: Project Report

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
120 h	0 h	30 h	0 h	0 h	150 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

Foreign Language Italian

Module Code: DLFLI

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language Italian)

Contributing Courses to Module
▪ Foreign Language Italian (DLFLI01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Depending on the CEFR classification, students are qualified to
  - understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves – e.g. where they live, who they know, or what things they have – and answer questions of this kind. They can communicate in a simple way if the other party speaks slowly and clearly and is willing to help. (Level A1)**
  - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, and local area). They can communicate in simple, routine situations that involve a simple and direct exchange of information about familiar and common things. They can use simple language to describe their own background and education, their immediate environment, and things related to immediate needs. (Level A2)**
  - understand the main points when clear standard language is used and when it comes to familiar matters from work, school, and leisure, etc. They can cope with most situations encountered when traveling in an area where the language is spoken. They can express themselves simply and coherently on familiar topics and personal areas of interest. They can report on experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for their plans and views. (Level B1) **
  - understand the main contents of complex texts on concrete and abstract topics and, in their own field, also technical discussions. They can communicate so spontaneously and fluently that a normal conversation with native speakers is possible without much effort on both sides. They can express themselves clearly and in detail on a wide range of topics, explain a point of view on a topical issue, and indicate the advantages and disadvantages of different options. (Level B2) **
  - understand a wide range of demanding, longer texts and grasp implicit meanings. They can express themselves spontaneously and fluently without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. They can express themselves in a clear, structured, and detailed manner on complex issues, using various means of text linking appropriately. (Level C1)***
- Grammar:
  - Level A1 – includes present and past tenses, sentence construction, and prepositions, etc.
  - Level A2 – includes historical tenses, differences in times of the past, imperative, subordinate clauses, and pronouns (dative, accusative)
  - Level B1 - among others, an introduction of the pluperfect, conjunctions, the passive, adverbs, adjectives (difference), and the future tense
  - Level B2 - includes verb constructions, conditional sentences, and indirect speech, etc.
  - Level C1 - Exercises to consolidate and repeat what has been learned
- **Source:
  http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp
  and
  http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf
- *** Source:
  http://www.goethe.de/z/50/commeuro/303.htm

Learning Outcomes	
Foreign Language Italian On successful completion, students will be able to	
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 IUBH** All Distance Learning Bachelor Programmes

Foreign Language Italian

Course Code: DLFLI01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

The qualification goals correspond to level A1-C1 according to the criteria of the Common European Framework of Reference for Languages (CEFR).A1-A2: The basic use of Italian as a foreign language is taught and practiced on the basis of everyday topics and basic grammatical structures.B1: With an expansion of grammatical knowledge and skills and the development of vocabulary in fields such as everyday working life, culture, business, and current events, the independent use of Italian as a foreign language is taught and practiced.B2: The independent use of Italian as a foreign language is taught and practiced by broadening and deepening previous grammatical knowledge and skills and expanding vocabulary in fields such as everyday work, culture, business, professional specializations, and current events.C1: The independent use of the foreign language Italian is taught and practiced with an extension and deepening of the previous grammatical knowledge and skills and the expansion of the vocabulary in fields such as everyday working life, culture, economics, professional specializations, and current events.Course Objectives and Outcome:Course Objectives and Outcome:A1-A2: Upon successful completion of the course, students can use Italian in everyday situations at level A1-A2 CEFR.B1: Upon successful completion of the course, students can use Italian in everyday situations at B1 CEFR level. Starting at this level, students are able to develop their language skills independently through application and further self-study.B2: Upon successful completion of the course, students will be able to independently use Italian at the B2 CEFR level in most daily and professional situations. They are able to express themselves on a wide range of topics, understand specialist discussions in their own specialist field, and communicate spontaneously and fluently so that a normal conversation with native speakers is possible without great effort. Starting from this level, the students can further develop their language skills with further self-study. C1: Upon successful completion of the course, students will be able to express themselves fluently and spontaneously without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. Students can express themselves in a clear, structured, and detailed way on complex subjects, using various means of text linking appropriately. Starting from this level, the students can further develop their language skills in application and with further self-study.Course Content:The students are able to:Themes: Family (description and introduction of themselves, description and introduction of friends, colleagues and acquaintances); Living (living situation, places of residence); Leisure (shopping, hobbies, traveling, forms of travel, and recreation); Telephoning, reservations, confirmation of orders, feedback; Communication: "Small talk", meetings; Description of their living situation (living, work, and leisure)Grammar: includes past and present tense, sentence construction, and prepositions, etc.Contents of the course A2:The students are able to:Themes everyday life, work, education, studies; work situation, fields of work, places of work, professional goals; personality, description of characteristics; making appointments and agreements; communication: "small talk", talks about places of work, fields of work; description of work situationGrammar: includes imperfect and perfect tenses, the subjunctive, modal verbs, and syntaxContents of the course B1:The students are able to:Thematic: environment: description of places and countries (location, people, places of interest, and special features, etc.); events in business, culture, and politics of immediate importance; use of the foreign language in everyday professional situations; writing: coherent description of places, situations, experiences, recommendations; communication: dialogues, short lecturesGrammar: Training and extension of the applicable sentence tree possibilities (including the subjunctive in various tenses, imperatives, modal verbs, and relative clauses, etc.)Contents of the course B2:The students are able to:Themes: the work day, distribution, sales, communication, human resources, career, solutions for private and business tasksGrammar: includes verb constructions, conditional sentences, and indirect speech, etc.Contents of the course C1:The students are able to:Themes: describe complex issues in detail, link topics with each other, paying special attention to certain aspects, and giving an appropriate conclusionGrammar: includes verb constructions, conditional

Course Outcomes
On successful completion, students will be able to
Contents

Literature
Compulsory Reading
Further Reading ▪ according to the online course Rosetta Stone

Study Format Distance Learning

Study Format	Course Type
Distance Learning	

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☑ Guideline ☐ Live Tutorium/Course Feed

DLFLI01

Foreign Language French

Module Code: DLFLF

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N (Foreign Language French)

Contributing Courses to Module
▪ Foreign Language French (DLFLF01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Depending on the CEFR classification, students are qualified to
    - understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves – e.g., where they live, who they know, or what things they have – and answer questions of this kind. They can communicate in a simple way if the other party speaks slowly and clearly and is willing to help. (Level A1)**
    - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g., personal and family information, shopping, work, and their local area). They can communicate in simple, routine situations that involve a simple and direct exchange of information about familiar and common things. They can use simple language to describe their own background and education, their immediate environment, and things related to their immediate needs. (level A2)**
    - understand the main points when clear standard language is used and when it comes to familiar matters about work, school, and leisure, etc. They can cope with most situations encountered when traveling in an area where the language is spoken. They can express themselves simply and coherently on familiar topics and personal areas of interest. They can report on experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for their plans and views. (level B1) **
    - understand the main contents of complex texts on concrete and abstract topics and, in their own field, also technical discussions. They can communicate spontaneously and fluently so that a normal conversation with native speakers is possible without much effort. They can express themselves clearly and in detail on a wide range of topics, explain a point of view on a topical issue, and indicate the advantages and disadvantages of different options. (level B2) **
    - understand a wide range of demanding, longer texts and also grasp implicit meanings. They can express themselves spontaneously and fluently without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. They can express themselves in a clear, structured, and detailed manner on complex issues, using various means of text linking appropriately. (level C1)***
- Grammar:
    - Level A1 – includes present and past tenses, sentence construction, and prepositions, etc.
    - Level A2 – includes historical tenses, differences in times of the past, imperative, subordinate clauses, and pronouns (dative, accusative)
    - Level B1 – Among others, an introduction of the pluperfect, conjunctions, the passive, adverbs, adjectives (difference), and the future tense
    - Level B2 – Includes verb constructions, conditional sentences, and indirect speech, etc.
    - Level C1 – Exercises to consolidate and repeat what has been learned
- **Source
http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp
and
http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf
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Learning Outcomes	
Foreign Language French On successful completion, students will be able to	
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 IUBH** All Distance Learning Bachelor Programmes

Foreign Language French

Course Code: DLFLF01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

The qualification goals correspond to levels A1 through C1, according to the criteria of the Common European Framework of Reference for Languages (CEFR).A1/A2: The basics of French as a foreign language are taught and practiced using everyday topics and simple grammatical structures.B1: Independent use of French as a foreign language is taught, expanding the learner’s grammatical knowledge and skills and developing their vocabulary in areas such as everyday working life, culture, business, and current events.B2: Independent use of French as a foreign language is taught and practiced by broadening and deepening previous grammatical knowledge and skills and expanding vocabulary in areas such as everyday work, culture, business, professional specializations, and current events.C1: Independent use of French as a foreign language is taught and practiced with a focus on extending and deepening previous grammatical knowledge and skills and expanding vocabulary in areas such as everyday working life, culture, economics, professional specializations, and current events.Course Objectives and Outcome:A1/A2: Upon successful completion of the course, students can use French in everyday situations at level A1/A2 CEFR.B1: Upon successful completion of the course, students can use French in everyday situations at level B1 CEFR. Starting at this level, students are able to develop their language skills independently through application and further self-study.B2: Upon successful completion of the course, students will be able to independently use French at the level B2 CEFR in most professional situations. They are able to express themselves on a wide range of topics, understand specialist discussions in their own specialist field, and communicate spontaneously and fluently so that a normal conversation with native speakers is possible without great effort. Starting from this level, students can further develop their language skills in application and with further self-study. C1: Upon successful completion of the course, students will be able to express themselves fluently and spontaneously without often having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. Students can express themselves in a clear, structured, and detailed way on complex subjects, using various means of text linking appropriately. Starting from this level, the students can further develop their language skills in application and with further self-study.Course Content:The students are able to:Themes: Family (description and introduction of themselves, description and introduction of friends, colleagues, and acquaintances); Living (living situation and places of residence); Leisure (shopping, hobbies, traveling, forms of travel, and recreation); Telephoning, reservations, confirmation of orders, and feedback; Communication: "Small talk", meetings; Description of life situation (living, work, and leisure)Grammar: Includes present and past tense, sentence construction, and prepositions, etc.Contents of the course A2:The students are able to:Themes: everyday life, work, education, studies; work situation, fields of work, places of work, professional goals; personality, description of characteristics; making appointments and agreements; communication: "small talk", talks about places of work, fields of work; description of their work.Grammar: among other things, the imperfect and subjunctive tenses, modal verbs, and sentence constructionContents of the course B1:The students are able to:Themes: environment: description of places and countries (location, people, places of interest, and special features, etc.); events in business, culture, and politics of immediate importance; use of the foreign language in everyday professional situations; writing: coherent description of places, situations, experiences, recommendations; communication: dialogues and short lecturesGrammar: Training and extension of the applicable sentence tree possibilities (including the subjunctive in various tenses, the imperative, modal verbs, and relative clauses, etc.)Contents of the course B2:The students are able to:Themes: working day, distribution, sales, communication, human resources, career, solutions for private and business tasksGrammar: includes verb constructions, conditional sentences, and indirect speech, etc.Contents of the course C1:The students are able to:Themes: describe complex issues in detail, link topics with each other, paying special attention to certain aspects and giving an appropriate conclusion.Grammar: includes verb constructions, conditional sentences, and

Course Outcomes
On successful completion, students will be able to
Contents

Literature
Compulsory Reading
Further Reading
▪ according to the online course Rosetta Stone

Study Format Distance Learning

Study Format	Course Type
Distance Learning	

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

DLFLF01

German Language

Module Code: DLSPGLA

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language: German)

Contributing Courses to Module
▪ Foreign Language: German (DLSPGLA01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents
Based on general and the use of basic and advanced grammar structures, the students will learn and practice German as a Foreign Language following a CEFRL assessment test.

Learning Outcomes	
Foreign Language: German On successful completion, students will be able to ▪ use German as a Foreign Language on the corresponding CEFRL level. The qualifications aimed at correspond to the A1, A2, B1, B2 and C1 levels in accordance with the criteria of the Common European Framework of Reference for Languages (CEFRL).	
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 IUBH** All Distance Learning Bachelor Programmes

Foreign Language: German

Course Code: DLSPGLA01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

Depending on the chosen CEFRL level, the students will be enabled to: **A1understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type. Introduce him/herself and others and can ask and answer questions about personal details such as where he/she lives, people he/she knows and things he/she has. Interact in a simple way provided the other person talks slowly and clearly and is prepared to help.A2understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment). Communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. Describe in simple terms aspects of his/her background, immediate environment and matters in areas of immediate need.B1understand the main points of clear standard input on familiar matters regularly encountered in work, school, leisure, etc. Deal with most situations likely to arise whilst travelling in an area where the language is spoken. Produce simple connected text on topics, which are familiar, or of personal interest. Describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.B2understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialization. Interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and Independent disadvantages of various options.C1understand a wide range of sophisticated, longer texts and to grasp implicit meanings. They can express themselves spontaneously and fluently, without having to search for words more clearly. They can use the language effectively and flexibly in their social and professional life or in education and study. They can speak clearly, in a structured manner and in detail about complex issues, using various means of linking text appropriately.**source: http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf and http://www.goethe.de/z/50/commeuro/303.htm

Course Outcomes

On successful completion, students will be able to

- use German as a Foreign Language on the corresponding CEFRL level. The qualifications aimed at correspond to the A1, A2, B1, B2 and C1 levels in accordance with the criteria of the Common European Framework of Reference for Languages (CEFRL).

Contents

Literature
Compulsory Reading
Further Reading ▪ Hagner, V./ Schlüter, S. (2013): Im Beruf. Deutsch als Fremd- und Zweitsprache. Hueber Verlag, München. ▪ Perlmann-Balme, M./ Schwalb, S./ Matussek, Magdalena (2013): Sicher! B2/1. Deutsch als Fremdsprache. Hueber Verlag, München. ▪ Eismann, Volker (2006): Training berufliche Kommunikation. B2-C1 - Erfolgreich bei Präsentationen. Kursbuch mit CD Taschenbuch. Cornelsen Verlag, Berlin.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

DLSPGLA01

Foreign Language Spanish

Module Code: DLFLS

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
see curriculum	Minimaldauer: 1 Semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language Spanish)

Contributing Courses to Module
▪ Foreign Language Spanish (DLFLS01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents

- Depending on the CEFR classification, students will be able to
  - understand and use familiar everyday expressions and very simple sentences aimed at satisfying concrete needs. They can introduce themselves and others and ask other people questions about themselves - e.g., where they live, who they know, or what things they have - and provide answers to these kinds of questions. They can communicate in a simple way if the other party speaks slowly and clearly and is willing to help (Level A1).**
  - understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. personal and family information, shopping, work, and their local area). They can communicate in simple, routine situations that involve a simple and direct exchange of information about familiar and common things. They can use simple language to describe their own background and education, their immediate environment, and things related to their immediate needs (Level A2)**
  - understand the main points when clear standard language is used and when it comes to familiar matters about work, school, leisure, etc. They can cope with most situations encountered when travelling in an area where the language is spoken. They can express themselves simply and coherently on familiar topics and personal areas of interest. They can report on experiences and events, describe dreams, hopes and goals, and give brief reasons or explanations for their plans and views. (Level B1) **
  - understand the main content of complex texts on concrete and abstract topics and, in their own field, also technical discussions. They can communicate spontaneously and fluently so that a normal conversation with native speakers is possible without much mutual effort. They can express themselves clearly and in detail on a wide range of topics, explain a point of view on a topical issue, and indicate the advantages and disadvantages of different options. (Level B2) **
  - understand a wide range of demanding, longer texts and also grasp implicit meanings. They can express themselves spontaneously and fluently without having to search for words. They can use the language effectively and flexibly in social and professional life or in training and studies. They can express themselves in a clear, structured, and detailed manner on complex issues, using various means of text linking appropriately. (level C1)***
- Grammar:
  - Level A1 - Includes present and past tenses, sentence construction, and prepositions, etc.
  - Level A2 - Includes historical tenses, differences in times of the past, imperative, subordinate clauses, and pronouns (dative, accusative)
  - Level B1 - Among others, introduces the pluperfect, conjunctions, the passive, adverbs, adjectives (difference), and the future tense
  - Level B2 - Includes verb constructions, conditional sentences, and indirect speech, etc.
  - Level C1 – Includes exercises to consolidate and repeat what has been learned
- **Source
  http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp
  and
  http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf
- ***Source
  http://www.goethe.de/z/50/commeuro/303.htm=- sync:ßÇÈâÈâ

Learning Outcomes	
Foreign Language Spanish On successful completion, students will be able to	
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 IUBH** All Distance Learning Bachelor Programmes

Foreign Language Spanish

Course Code: DLFLS01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

Study goals correspond to the language levels A1-C1, as specified in the Common European Framework of Reference for Languages (CEFR).A1-A2: The basic use of Spanish as a foreign language is taught and practiced on the basis of everyday topics and basic grammatical structures.B1: With an expansion of grammatical knowledge and skills and the development of vocabulary in fields such as everyday working life, culture, business and current events, the independent use of Spanish is taught and practiced.B2: The independent use of Spanish is taught and practiced with an extension and deepening of the previous grammatical knowledge and skills and the expansion of the vocabulary in fields such as everyday working life, culture, economics, professional specializations, and current events.C1: The independent use of Spanish is taught and practiced with an extension and deepening of the previous grammatical knowledge and skills and the expansion of the vocabulary in fields such as everyday working life, culture, economics, professional specializations, and current events.Course Objectives and Outcome:Course Objectives and Outcome:A1-A2: Upon successful completion of the course, students can use Spanish in everyday situations at level A1-A2 CEFR.B1: Upon successful completion of the course, students can use Spanish in everyday situations at B1 CEFR level. Starting at this level, students are able to develop their language skills independently through application and further self-study.B2: Upon successful completion of the course, students will be able to independently use Spanish at the B2 CEFR level in most daily and professional situations. They are able to express themselves on a wide range of topics in order to understand specialist discussions in their own specialist field, and to communicate spontaneously and fluently so that a normal conversation with native speakers is possible without great effort being made by either side. Starting from this level, students can further develop their language with further self-study.C1: Upon successful completion of the course, students will be able to express themselves fluently and spontaneously without having to search for words often. They can use the language effectively and flexibly in social and professional life or in training and studies. Students can express themselves in a clear, structured and detailed way on complex subjects, using various means of text linking appropriately. Starting from this level, the students can further develop their language skills with further self-study.Course Content:The students are able to:Themes: Family (description and introduction of themselves, description and introduction of friends, colleagues, and acquaintances); Living (living situation, places of residence); Leisure (shopping, hobbies, travelling, forms of travel, and recreation); Telephoning, reservation, confirmation of order, feedback; Communication: "Small talk", meetings; Description of daily life (living, work, and leisure)Grammar: includes present and past tense, sentence construction, and prepositions, etc.Contents of the course A2:The students are able to:Themes: everyday life, work, education, and studies; work situation, fields of work, places of work, professional goals; personality and description of characteristics; making appointments and agreements; communication: "small talk", talking about places of work, fields of work, describing their work situation.Grammar: includes the perfect and imperfect tenses, the subjunctive, modal verbs, and sentence structureContents of the course B1:The students are able to:Themes: environment: description of places and countries (location, people, places of interest, and special features, etc.); events in business, culture, and politics of immediate importance; use of the foreign language in everyday professional situations; writing: coherent description of places, situations, experiences, recommendations; communication: dialogues and short lectures.Grammar: Training and extension of the applicable sentence tree possibilities (including subjunctive in various tenses, imperative, modal verbs, and relative clauses, etc.)Contents of the course B2:The students are able to:Themes: working day, distribution, sales, communication, human resources, career, solutions for private and business tasksGrammar: includes verb constructions, conditional sentences, and indirect speech, etc.Contents of the course C1:The students are able to: Thematically: describe complex issues in detail, link topics with each other, paying special attention to certain aspects and giving an appropriate conclusionGrammar: including verb

Course Outcomes
On successful completion, students will be able to
Contents

Literature
Compulsory Reading
Further Reading ▪ according to the online course Rosetta Stone

Study Format Distance Learning

Study Format	Course Type
Distance Learning	

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods

- ☐ Learning Sprints®
- ☐ Course Book
- ☐ Vodcast
- ☐ Shortcast
- ☐ Audio
- ☐ Exam Template
- ☐ Review Book
- ☐ Creative Lab
- ☑ Guideline
- ☐ Live Tutorium/Course Feed

Foreign Language Turkish

Module Code: DLFLT

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
see curriculum	Minimum 1 semester	WiSe/SoSe	English

Module Coordinator
N.N. (Foreign Language Turkish)

Contributing Courses to Module
▪ Foreign Language Turkish (DLFLT01)

Module Exam Type	
Module Exam Study Format: Distance Learning Exam, 180 Minutes	**Split Exam**
Weight of Module see curriculum	

Module Contents
▪ Depending on the acquired CEFR level, students are enabled to ▪ understand and use familiar, everyday expressions and very simple sentences aimed at the fulfilment of fundamental needs. Students can introduce themselves and others, ask and answer questions about themselves and others, such as where they live, people they know and things they own. 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) ** ▪ understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. personal and family information, shopping, work, accustomed settings). Students can communicate in simple, familiar situations involving a basic and direct exchange of information on habitual and predictable issues. They can describe their own background and education, their immediate environment and things related to immediate needs in simple expressions. (Level A2) ▪ Grammar: ▪ Level A1 - among other things tenses of the present and past, sentence structure ▪ Level A2 – among other things tenses of the past, differences in past tenses, imperative, subordinate clauses, pronouns ▪ **Source http://www.coe.int/t/dg4/linguistic/Cadre1_en.asp and http://www.coe.int/t/dg4/linguistic/Source/Framework_EN.pdf ▪ *** Source: http://www.goethe.de/z/50/commeuro/303.htm

Learning Outcomes
Foreign Language Turkish On successful completion, students will be able to

Links to other Modules within the Study Program	Links to other Study Programs of IUBH
This module is similar to other modules in the field of Languages	All Distance Learning Bachelor Programmes

Foreign Language Turkish

Course Code: DLFLT01

Study Level	Language of Instruction	Contact Hours	CP	Admission Requirements
BA	English		10	none

Course Description

Description of the course:The qualification objectives correspond to levels A1-A2 following the criteria of the Common European Framework of Reference for Languages (CEFR).A1-A2: The elementary use of the foreign language Turkish is taught and practiced on the basis of everyday topics and using elementary grammatical structures.Course objectives:A1-A2: After successful completion of the course, students can use Turkish in everyday situations at the A1 CEFR level.Contents of the course A1:Students are enabled to,Thematic: family (description and introduction of oneself, description and introduction of friends, colleagues and acquaintances); residence (living situation, places of residence); leisure time (shopping, hobbies, travelling, forms of travel, recreation); telephoning, reservations, order confirmation, feedback; communication: "small talk", getting to know each other; description of life situation (living, work, leisure time)Grammar: among other things tenses of the present and past, sentence structureContents of the course A2:Students are enabled to,Thematic: everyday life, work, training, studies; work situation, fields of work, places of work, professional goals; personality, description of character traits; making appointments and agreements; communication: "small talk", conversations about places of work, fields of work; description of the working environmentGrammar: among other things, tenses of the past, sentence structure

Course Outcomes

On successful completion, students will be able to

Contents

Literature

Compulsory Reading

Further Reading

- according to information in the online course Rosetta Stone

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Online Lecture

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** no
Type of Exam	Exam, 180 Minutes

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
180 h	0 h	60 h	60 h	0 h	300 h

Instructional Methods	
☐ Learning Sprints®	☐ Review Book
☐ Course Book	☐ Creative Lab
☐ Vodcast	☑ Guideline
☐ Shortcast	☐ Live Tutorium/Course Feed
☐ Audio	
☐ Exam Template	

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
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 "Distance Learning": Written Assessment: Bachelor Thesis Colloquium • Study Format "Distance Learning": Presentation: 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 IUBH
All modules in the bachelor program	All bachelor programs in distance learning

Bachelor Thesis

Course Code: DLBBT01

Study Level	Language of Instruction	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 ▪ Hunziker, A.W. (2010): Spaß am wissenschaftlichen Arbeiten. So schreiben Sie eine gute Semester-, Bachelor- oder Masterarbeit. 4. Auflage, Verlag SKV, Zürich. ▪ Wehrlin, U. (2010): Wissenschaftliches Arbeiten und Schreiben. Leitfaden zur Erstellung von Bachelorarbeit, Masterarbeit und Dissertation – von der Recherche bis zur Buchveröffentlichung. AVM, München. ▪ Selection of literature according to topic

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** yes
Type of Exam	Written Assessment: Bachelor Thesis

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
270 h	0 h	0 h	0 h	0 h	270 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☑ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed

Colloquium

Course Code: DLBBT02

Study Level	Language of Instruction	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

- Renz, K.-C. (2016): Das 1 x 1 der Präsentation. Für Schule, Studium und Beruf. 2. Auflage, Springer Gabler, Wiesbaden.

Study Format Distance Learning

Study Format	Course Type
Distance Learning	Thesis Defense

Information about the examination	
Examination Admission Requirements	**BOLK:** no **Course Evaluation:** yes
Type of Exam	Presentation: Colloquium

Student Workload					
Self Study	**Presence**	**Tutorial**	**Self Test**	**Practical Experience**	**Hours Total**
30 h	0 h	0 h	0 h	0 h	30 h

Instructional Methods	
☐ Learning Sprints® ☐ Course Book ☐ Vodcast ☐ Shortcast ☐ Audio ☐ Exam Template	☐ Review Book ☐ Creative Lab ☐ Guideline ☐ Live Tutorium/Course Feed