TUHH
Hamburg
University of
Technology

Module Manual

Bachelor of Science (B.Sc.)

Engineering and Management - Major in Logistics and Mobility

Cohort: Winter Term 2022

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Program description

Content

Economic development with its rapid change in products and processes has also led, among other things, to a considerable restructuring of the inter-company division of labor. Today, this division of labor is characterized by cross-company value chains in which complex production processes have to be planned, sustainably designed and controlled. Logistics and its basic functions, transport, handling and warehousing, play a central role in this. Mobility is understood in the sense of social participation and opportunities for movement. Successful, socially and ecologically compatible economic activity under such conditions is made possible by the interaction of innovative technical systems, information and communication technologies, and management strategies.

The bachelor's degree program "Engineering and Management - Major in Logistics and Mobility" prepares graduates for professional activities in this interdisciplinary field. Extensive, interdisciplinary basic knowledge from the natural and engineering sciences and from business administration is taught. The effects on society as a whole are always included. By working on a wide range of tasks from various application areas of logistics and mobility, students also learn how to deal with specific issues, thus acquiring a meaningful mix of practical and scientific skills.

Career prospects

Graduates of the program can enter directly into professions in the field of logistics or transportation planning. The degree program prepares them for independent and joint activities in responsible positions.

Possible employers include, for example, companies in the logistics sector, trading companies, manufacturing companies, engineering and planning offices, transport companies, construction companies, infrastructure operators and the public sector.

At Hamburg University of Technology, graduates have the opportunity, among other things, to follow the bachelor's degree program in "Engineering and Management - Major in Logistics and Mobility" with a master's degree in "Logistics, Infrastructure, and Mobility" or in "International Management and Engineering".

Learning target

The bachelor's degree program in "Engineering and Management - Major in Logistics and Mobility" prepares students both for a professional career and for a relevant master's degree program. The basic methodological knowledge required for this is acquired during the course of study. The learning outcomes of the program are achieved through an interplay of basic and advanced modules from the fields of logistics, engineering and business administration and can be specialized in one of three specializations. The learning objectives are divided below into the categories of knowledge, skills, social competence and independence.

Knowledge
Knowledge is constituted by facts, principles and theories and is acquired in the Bachelor's program "Engineering and Management - Major in Logistics and Mobility" in the following areas:

1. Graduates are able to explain the basic methods, procedures and interrelationships of engineering sciences, in particular mathematics, engineering mechanics and computer science.
2. Graduates will be able to explain the basic methods, procedures and interrelationships of economics, business administration and management.
3. Graduates will be able to explain the methods, procedures and interrelationships of logistics and transportation planning and provide an overview of their subject and the interrelationships between the sub-disciplines of logistics.
4. Graduates are able to place their subject in the overall societal, social and economic context.

Skills
The ability to apply acquired knowledge in order to solve specific problems is supported in many ways in the degree program "Engineering and Management - Major in Logistics and Mobility":

1. Graduates are able to solve technical problems, as well as design new technical systems of logistics and transportation systems.
2. Graduates are able to evaluate technical systems of logistics and transport systems economically and ecologically.
3. Graduates are able to analyze, plan, design and control the flow systems (goods, people, information, money) necessary for the production of goods or the provision of services and to apply their theoretical knowledge in practical problems. Due to their holistic and analytical thinking, graduates are also able to penetrate and optimize networked processes.

Social competence
Social competence comprises the individual ability and willingness to work together with others in a goal-oriented manner, to understand the interests of others, to communicate and to help shape the working and living environment.

1. Graduates can integrate themselves into professionally homogeneous teams, organize themselves in these teams, take on specific subtasks and reflect on their own contribution.
2. Graduates are able to integrate themselves into heterogeneous teams, to organize themselves in these teams, to take on specific subtasks and to reflect on their own contribution.
3. Graduates are able to communicate about the contents of logistics and mobility as well as the results of their own work in an appropriate manner with both experts and laypersons.
4. Graduates are able to classify the social and ecological effects of logistics and transport systems on society and the environment.

Self-reliance
Personal competencies include not only the competence to act independently, but also the system and solution competencies to represent general problems as specific sub-problems as well as the selection and mastery of suitable methods and procedures for problem solving.

1. Graduates are able to realistically assess their competencies and work on deficits independently.
2. Graduates have the ability to formulate their findings precisely in writing and orally.
3. Graduates are able to independently work on sub-projects in more complex logistics and transport planning projects on the basis of the knowledge and skills they have acquired during their studies.
4. Graduates can reliably apply methods of scientific work and are thus also qualified to work in research or to deepen their competencies in a more advanced course of study.

Program structure

The curriculum of the Bachelor's degree program "Engineering and Management - Major in Logistics and Mobility" is structured as follows:

- Core qualification, 19 compulsory modules, 3 compulsory elective modules, 132 LP, 1st-5th semester.
- Consolidation, 3 compulsory modules, 3 compulsory elective modules, 36 LP, 4th semester onwards
- Bachelor thesis, 12 LP, 6th semester

This results in a total of 180 LP.

In the core qualification, students are taught the fundamentals of mathematics, engineering, business administration, logistics and mobility, primarily in the first four semesters. In addition, there is a compulsory elective module in applied business administration, a freely selectable technical and a freely selectable non-technical supplementary module. A student research project in the fifth semester prepares students for their final thesis.

Starting in the 4th semester, students choose one of the three specializations:

- Transport planning and systems
- Production management and processes
- Information Technology

A specialization consists of three compulsory modules and three elective modules.

The fifth semester is kept as free as possible due to the high number of elective modules. This makes it possible to complete the fifth semester abroad.

The sixth semester is devoted to writing the bachelor's thesis.

Core Qualification

Students gain basic knowledge as well as deepend skills in mathematics and business administration.

Module M0650: Introduction to Logistics and Mobility

Courses

Title	Typ	Hrs/wk	CP
Introduction to Scientific Work (L0474)	Lecture	1	2
Freight Traffic and Logistics (L0390)	Lecture	2	2
Freight Traffic and Logistics (L0391)	Project-/problem-based Learning	2	2

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can... • describe the historical development of logistics • name the basic functions of logistics • describe supply chain management, logistics concepts, mobility management and systems analysis • describe the connection between logistics and traffic and spatial development • estimate the environmental impact of logistical decisions
Skills	Students can... • apply basic concepts and methods of logistics phase systems • analyze logistical systems and select alternative logistics concepts to improve the sustainability of companies • solve problems systematically
Personal Competence	
Social Competence	Students can... • collaborate in groups to reach and record work outcomes • give appropriate feedback and deal constructively with feedback on their work
Autonomy	Students can... • assess their own learning progress • conduct literature research and analyses independently and cite them properly • organize and complete the work set independently in terms of both time and content • produce written work independently
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6

Course achievement

Compulsory	Bonus	Form	Description
No	2.5 %	Presentation	
No	2.5 %	Excercises	
No	2.5 %	Written elaboration	
No	2.5 %	Written elaboration	

Examination	Written exam
Examination duration and scale	Written exam 60 minutes. 2.5% bonus points each: Excerpt (1 page), homework in group (approx. 20 pages), presentation homework in group (25 minutes), weekly participation in JiTT-questions (10 weeks)
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L0474: Introduction to Scientific Work	
Typ	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Meike Schröder
Language	DE
Cycle	WiSe
Content	• Introduction to research and science • Finding a topic • Literature review (finding, organizing and analyzing literature, databanks) • Correct citing (adequate behavior with regard to literature, plagiarism, citation types, citation programs) • Structuring a scientific work (organizing material, research questions, exposée, arguments, structure) • Formating and layout (grouping, foot notes, formating in word) • Writing of an excerpt for the term paper and written exam • Discussing possible questions of the exam
Literature	• Beinke, Christiane; Brinkschulte, Melanie; Bunn, Lothar; Thürmer, Stefan (2011): Die Seminararbeit. Schreiben für den Leser. 2., völlig überarb. Aufl. Konstanz: UVK-Verlagsgesellschaft. • Bitterlich, Axel; Bünting, Karl-Dieter; Pospiech, Ulrike (2007): Schreiben im Studium: mit Erfolg. Ein Leitfaden. 7. Aufl. Berlin: Cornelsen Scriptor. • Boeglin, Martha (2011): Wissenschaftlich arbeiten Schritt für Schritt. Gelassen und effektiv studieren. 2., Aufl. Paderborn, Paderborn: UTB; Fink, Wilhelm. • Brink, Alfred (2013): Anfertigung wissenschaftlicher Arbeiten. Wiesbaden: Springer Fachmedien Wiesbaden. • Hirsch-Weber, Andreas; Scherer, Stefan (2016): Wissenschaftliches Schreiben und Abschlussarbeit in Naturwissenschaften und Ingenieurwissenschaften. Grundlagen - Praxisbeispiele - Übungen. Stuttgart: Verlag Eugen Ulmer. • Kollmann, Tobias; Kuckertz, Andreas; Stöckmann, Christoph (2016): Das 1 x 1 des Wissenschaftlichen Arbeitens. Wiesbaden: Springer Fachmedien Wiesbaden. • Niederhauser, Jürg (2015): Die schriftliche Arbeit kompakt. Von der Ideenfindung bis zur fertigen Arbeit. Für Schule, Hochschule und Universität. 2., aktualisierte und überarb. Aufl. Berlin: Dudenverlag. • Oehlrich, Marcus (2015): Wissenschaftliches Arbeiten und Schreiben. Berlin, Heidelberg: Springer Berlin Heidelberg. • Rost, Friedrich (2012): Lern- und Arbeitstechniken für das Studium. Wiesbaden: VS Verlag für Sozialwissenschaften. • Sesink, Werner (2012): Einführung in das wissenschaftliche Arbeiten. Inklusive E-Learning, Web-Recherche, digitale Präsentation u.a. 9., aktualisierte Aufl. München: Oldenbourg. • Sommer, Roy (2006): Schreibkompetenzen. Erfolgreich wissenschaftlich schreiben. Stuttgart: Klett Lernen und Wissen. • Spoun, Sascha (2011): Erfolgreich studieren. 2., aktualisierte Aufl. München: Pearson Studium. • Theisen, Manuel René (2013): Wissenschaftliches Arbeiten: Erfolgreich bei Bachelor- und Masterarbeit. 16., vollständig überarbeitete Auflage. München: Vahlen. • Voss, Rödiger (2016): Wissenschaftliches Arbeiten ... leicht verständlich. Mit zahlreichen Abbildungen und Übersichten. 4., überarbeitete Auflage. Konstanz, München: UVK Verlagsgesellschaft mbH; UVK/Lucius.

Course L0390: Freight Traffic and Logistics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	WiSe

Content	The course gives an introductory overview of the basics of supply chain management and logistics and their interaction with freight traffic and thus the significance of traffic planning for business activities. In addition, examples of ecologically and economically sustainable best practice are discussed. The following subject areas are covered:
	• Historical development of logistics
	• Systemic thinking in logistics
	• Concepts, trends and strategies in the field of
	  ◦ Procurement logistics
	  ◦ Production logistics
	  ◦ Distribution logistics
	  ◦ Reverse logistics
	  ◦ Storage logistics
	  ◦ Transport logistics
	  ◦ Handling logistics
	• Basics of the connection between logistical decisions and traffic
	• Introduction to traffic policy
	• Scope for design of (sustainable) freight traffic and logistics
	The course contents will be consolidated by means of online surveys, Wiki entries by students and special practice sessions and illustrated by means of excursions.

Literature	ARNOLD, D., ISERMANN, H., KUHN, A., TEMPELMEIER, H. (Hrsg.) (2008): Handbuch Logistik. Berlin, Heidelberg, Springer-Verlag Berlin 3. neu bearb. Auflage. IHDE, G. B. (2001): Transport, Verkehr, Logistik, Gesamtwirtschafliche Aspekte und einzelwirtschaftliche Handhabung. München, Verlag Franz Vahlen, 3. völlig überarbeitete und erweiterte Auflage. PFOHL, H.-C. (2010): Logistiksysteme - Betriebswirtschaftliche Grundlagen. Berlin, Heidelberg, New York, Springer-Verlag, 8. neu bearb. Und aktualisierte Auflage.

Course L0391: Freight Traffic and Logistics	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0577: Non-technical Courses for Bachelors

Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	**The Non-technical Academic Programms (NTA)** imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its **teaching architecture**, in its **teaching and learning arrangements**, in **teaching areas** and by means of teaching offerings in which students can qualify by opting for **specific competences** and a **competence level** at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses. **The Learning Architecture** consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree courses. The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles" The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of studies. **Teaching and Learning Arrangements** provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses. **Fields of Teaching** are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migration studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way. The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations. **The Competence Level** of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc. This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life. **Specialized Competence (Knowledge)** Students can • locate selected specialized areas with the relevant non-technical mother discipline, • outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area, • different specialist disciplines relate to their own discipline and differentiate it as well as make connections, • sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity, • Can communicate in a foreign language in a manner appropriate to the subject.
Skills	**Professional Competence (Skills)** In selected sub-areas students can • apply basic methods of the said scientific disciplines, • auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline, • to handle simple questions in aforementioned scientific disciplines in a sucsessful manner, • justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.
Personal Competence	
Social Competence	**Personal Competences (Social Skills)** Students will be able • to learn to collaborate in different manner,

	• to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees, • to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen), • to explain nontechnical items to auditorium with technical background knowledge.
Autonomy	**Personal Competences (Self-reliance)** Students are able in selected areas • to reflect on their own profession and professionalism in the context of real-life fields of application • to organize themselves and their own learning processes • to reflect and decide questions in front of a broad education background • to communicate a nontechnical item in a competent way in writen form or verbaly • to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)
Workload in Hours	Depends on choice of courses
Credit points	6

Courses
Information regarding lectures and courses can be found in the corresponding module handbook published separately.

Module M0829: Foundations of Management

Courses

Title	Typ	Hrs/wk	CP
Management Tutorial (L0882)	Recitation Section (small)	2	3
Introduction to Management (L0880)	Lecture	3	3

Module Responsible	Prof. Christoph Ihl
Admission Requirements	None
Recommended Previous Knowledge	Basic Knowledge of Mathematics and Business
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to • explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management • explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects • describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing • explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance • state basics from accounting and costing and selected controlling methods.
Skills	Students are able to analyse business units with respect to different criteria (organization, objectives, strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems
Personal Competence	
Social Competence	Students are able to • work successfully in a team of students • to apply their knowledge from the lecture to an entrepreneurship project and write a coherent report on the project • to communicate appropriately and • to cooperate respectfully with their fellow students.
Autonomy	Students are able to • work in a team and to organize the team themselves • to write a report on their project.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	several written exams during the semester
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Bioprocess Engineering: Core Qualification: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L0882: Management Tutorial	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christoph Ihl, Katharina Roedelius
Language	DE
Cycle	WiSe/SoSe
Content	In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on se selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the busin knowledge from the lecture should come to practical use. The group projects are guided by a mentor.
Literature	Relevante Literatur aus der korrespondierenden Vorlesung.

Course L0880: Introduction to Management	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Christoph Ihl, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Cornelius Herstatt, Prof. Kathrin Fischer, Prof. Matthias Meyer, Prof. Thomas Wrona, Prof. Thorsten Blecker, Prof. Wolfgang Kersten
Language	DE
Cycle	WiSe/SoSe
Content	• Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management • Important definitions from Management, • Developing Objectives for Business, and their relation to important Business functions • Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management • Definitions as information, information systems, aspects of data security and strategic information systems • Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. • Relevance of marketing, B2B vs. B2C-Marketing • different techniques from the field of marketing (e.g. scenario technique), pricing strategies • important organizational structures • basics of human ressource management • Introduction to Business Planning and the steps of a planning process • Decision Analysis: Elements of decision problems and methods for solving decision problems • Selected Planning Tasks, e.g. Investment and Financial Decisions • Introduction to Accounting: Accounting, Balance-Sheets, Costing • Relevance of Controlling and selected Controlling methods • Important aspects of Entrepreneurship projects
Literature	Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006.

Module M0850: Mathematics I

Courses

Title	Typ	Hrs/wk	CP
Mathematics I (L2970)	Lecture	4	4
Mathematics I (L2971)	Recitation Section (large)	2	2
Mathematics I (L2972)	Recitation Section (small)	2	2

Module Responsible	Prof. Anusch Taraz
Admission Requirements	None
Recommended Previous Knowledge	School mathematics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in analysis and linear algebra. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112
Credit points	8
Course achievement	Compulsory: Yes; Bonus: 10 %; Form: Excercises; Description:
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2970: Mathematics I	
Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	WiSe
Content	Mathematical Foundations: sets, statements, induction, mappings, trigonometry Analysis: Foundations of differential calculus in one variable • natural and real numbers • convergence of sequences and series • continuous and differentiable functions • mean value theorems • Taylor series • calculus • error analysis • fixpoint iteration Linear Algebra: Foundations of linear algebra in R^n • vectors: rules, linear combinations, inner and cross product, lines and planes • systems of linear equations: Gauß elimination, linear mappings, matrix multiplication, inverse matrices, determinants • orthogonal projection in R^n, Gram-Schmidt-Orthonormalization
Literature	• T. Arens u.a. : Mathematik, Springer Spektrum, Heidelberg 2015 • W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 • W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 • G. Strang: Lineare Algebra, Springer-Verlag, 2003 • G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013

Course L2971: Mathematics I	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz, Dr. Dennis Clemens, Dr. Simon Campese
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2972: Mathematics I	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1802: Engineering Mechanics I (Stereostatics)

Courses

Title	Typ	Hrs/wk	CP
Engineering Mechanics I (Statics) (L1001)	Lecture	2	3
Engineering Mechanics I (Statics) (L1003)	Recitation Section (large)	1	1
Engineering Mechanics I (Statics) (L1002)	Recitation Section (small)	2	2

Module Responsible	Prof. Benedikt Kriegesmann
Admission Requirements	None
Recommended Previous Knowledge	Solid school knowledge in mathematics and physics.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students can • describe the axiomatic procedure used in mechanical contexts; • explain important steps in model design; • present technical knowledge in stereostatics.
Skills	The students can • explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; • apply basic statical methods to engineering problems; • estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets.
Personal Competence	
Social Competence	The students can work in groups and support each other to overcome difficulties.
Autonomy	Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L1001: Engineering Mechanics I (Statics)	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	• Tasks in Mechanics • Modelling and model elements • Vector calculus for forces and torques • Forces and equilibrium in space • Constraints and reactions, characterization of constraint systems • Planar and spatial truss structures • Internal forces and moments for beams and frames • Center of mass, volumn, area and line • Computation of center of mass by intergals, joint bodies • Friction (sliding and sticking) • Friction of ropes
Literature	**K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009).** **D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).**

Course L1003: Engineering Mechanics I (Statics)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

Course L1002: Engineering Mechanics I (Statics)	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams
Literature	K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011).

Module M1004: Logistics Management

Courses

Title	Typ	Hrs/wk	CP
Introduction into Production Logistics (L1222)	Lecture	2	2
Logistics Economics (L1221)	Project-/problem-based Learning	3	4

Module Responsible	Dr. Meike Schröder
Admission Requirements	None
Recommended Previous Knowledge	Introduction to Business and Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students will be able • to differentiate between production logistics and logistics services, • to describe internal and external areas of production and logistics management, • understand the difference between the different roles in a supply chain, • to describe and explain the actual challenges of production and Logistics management
Skills	Based on the acquired knowledge students are capable of • Analysing logistics problems and influence factors in companies, • Selecting appropriate methods for solving practical problems, • Applying methods and tools of logistics management for standardized problems.
Personal Competence	
Social Competence	Students can • actively participate in discussions and team sessions, • arrive at work results in groups and document them, • develop joint solutions in mixed teams and present them to others.
Autonomy	Students are able to - perform work steps for solving problems of business logistics independently with the aid of pointers - assess their own state of learning in specific terms and to define further work steps on this basis guided by teachers.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** **Bonus** **Form** **Description** No 20 % Subject theoretical and practical work
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Data Science: Specialisation II. Application: Elective Compulsory Logistics and Mobility: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L1222: Introduction into Production Logistics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Yong Lee
Language	DE
Cycle	SoSe
Content	In the era of time-competition production and logistics need to be considered as a combined strategic competitive advantage. "Introduction in to production logistics" gives an overview over the different disciplinces of production logistics: - Development from cost-, quality to time-competitiion, - fundamentals of production and logistics, - phase-oriented and functional subsystems of production logistics, - planning and steering, - analysis and optimization (focus: Lean Management), - production logistics controlling and supply-chain management in production network Theory is complented by case studies and guest presentations.
Literature	• Der Vorlesung zugrunde liegende Literatur (Auswahl): - Beer, Stafford (1988): Diagnosing the system for organizations. John Wiley & Sons. Chichester, New York, Brisbane, Toronto 1988. - Ferdows, Kasra; De Meyer, Arnoud (1990): Lasting Improvements in Manufacturing Performance In Search of a New Theory. In: Journal of Operations Management, Vol. 9 (2), 1990, S. 365-384. - Gudehus, Timm (2010): Logistik. Grundlagen - Strategien - Anwendungen. 4. aktual. Aufl. Springer Verlag. Heidelberg/Berlin 2010. - Günther, Hans-Otto/Tempelmeier, Horst (2012): Produktion und Logistik. 9., akt. u. erw. Aufl. Springer Verlag. Berlin/Heidelberg 2012. - Hayes, Robert H.; Schmenner, Roger (1978): How Should You Organize Ma-nufacturing?. In: Harvard Business Review, Vol. 56 (1), 1978, S. 105-118. - Krafcik, John F. (1988): Triumph of the lean production system. In: Sloan Management Review, Vol. 30 (1), S. 41-52. - Maskell, Brian H. (1989a): Performance Measurement for World Class Manufacturing. Part I. Manufacturing Systems, Vol. 7, 1989, S. 62-64. - Pawellek, Günther (2007): Produktionslogistik - Planung - Steuerung - Controlling. Carl Hanser Verlag. München 2007. - Nyhuis, Peter (2008): Beiträge zu einer Theorie der Logistik. Springer Verlag. Berlin/Heidelberg 2008. - Pfohl, Hans-Christian (2010): Logistiksysteme. Betriebswirtschaftliche Grundlagen. 8., neu bearb. u. aktual. Aufl. Springer Verlag. Berlin/Heidelberg 2010. - Schuh, Günther (1988): Gestaltung und Bewertung von Produktvarianten. Ein Beitrag zur systematischen Planung von Serienprodukten. Dissertation. RWTH Aachen 1988. - Takeda, Hitoshi (2012): Das synchrone Produktionssystem. Just-in-time für das ganze Unternehmen. 7. Aufl. Verlag Franz Vahlen. München 2012. - Ten Hompel, Michael/Sadowsky, Volker/Beck, Maria (2011): Kommissionierung. Materialflusssysteme 2 - Planung und Berechnung der Kommissionierung in der Logistik. Springer Verlag. Berlin/Heidelberg 2011. - Wannenwetsch, Helmut (2007): Integrierte Materialwirtschaft und Logistik. Beschaffung, Logistik, Materialwirtschaft und Produktion.3., akt. Aufl. Springer Verlag. Berlin/Heidelberg 2007. - Wiendahl, Hans-Peter/Reichardt, Jürgen/Nyhuis, Peter (2014): Handbuch Fabrikplanung. Konzept, Gestaltung und Umsetzung wandlungsfähiger Produktionsstätten. 2., überarb. u. erw. Aufl. Carl Hanser Verlag. München/Wien 2014. - Wildemann, Horst (1997): Fertigungsstrategien - Reorganisation für eine schlanke Produktion und Zulieferung. 3. Aufl. TCW Transfer-Centrum-Verlag. München 1997. - Wildemann, Horst (2008): Produktionssysteme. Leitfaden zur methoden-gestützten Reorganisation der Produktion. 6. Aufl. 2008, TCW München. - Wildemann, Horst (2009): Logistik Prozeßmanagement. 4. Aufl. TCW Transfer-Centrum-Verlag. München 2009. - Zäpfel, Günther (2001): Grundzüge des Produktions- und Logistikmanagement. 2., unwesentlich veränd. Aufl. R. Oldenbourg Verlag. München/Wien 2001.

Course L1221: Logistics Economics	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Meike Schröder
Language	DE
Cycle	SoSe
Content	• Explanation of basic concepts of logistics and outline of the scope of the logistics business, identification of global logistics networks and relationships • Stakeholder: Introduction to the different kinds of logistics service providers, characterization of services of consulting firms for logistics companies • Strategy: Influence of the business strategies on business logistics • Outsourcing: Decision processes, possibilities and risks of outsourcing of logistics services • Market: Logistics in Germany, relevance of logistics for the city of Hamburg • Research: Outlook on current issues in academic research, as well as an outline of supplementary management methods for logistics
Literature	• Arnold, D.; Isermann, H.; Kuhn, A.; Tempelmeier, H. (2008): Handbuch Logistik, Berlin: Springer, 2008, ISBN: 3-540-72928-3 • Ballou, R. H. (2004): Business logistics, supply chain management: planning, organizing, and controlling the supply chain, 5. ed., internat. ed., Upper Saddle River, NJ: Pearson Prentice Hall, 2004, ISBN: 0-13-123010-7 • Bretzke, W.-R. (2008): Logistische Netzwerke, Springer, Berlin, 2008 • Gleißner, H.; Femerling, C. (2008): Logistik - Grundlagen, Übungen, Fallbeispiele, Wiesbaden: Gabler, 2008, ISBN: 978-3-8349-0296-2 • Kersten, W.; Hohrath, P.; Koch, J. (2007): Innovative logistics services : Advantage and Disadvantages of Outsourcing Complex Service Bundles, in: Key Factors for Successful Logistics, Berlin: Erich Schmidt Verlag GmbH & Co. KG, 2007 • Kersten, W.; Koch, J. (2007): Motive für das Outsourcing komplexer Logistikdienstleistungen, in: Handbuch Kontraktlogistik : Management komplexer Logistikdienstleistungen, Weinheim • Schulte, C. (2009): Logistik: Wege zur Optimierung der Supply Chain, 5. überarb. und erw. Aufl., München: Vahlen, 2009, ISBN: 3-8006-3516-X • Wildemann, H. (1997): Logistik Prozessmanagement - Organisation und Methoden, München: TCW Transfer-Centrum Verlag, 1997, ISBN: 3-931511-17-0

Module M0851: Mathematics II

Courses

Title	Typ	Hrs/wk	CP
Mathematics II (L2976)	Lecture	4	4
Mathematics II (L2977)	Recitation Section (large)	2	2
Mathematics II (L2978)	Recitation Section (small)	2	2

Module Responsible	Prof. Anusch Taraz
Admission Requirements	None
Recommended Previous Knowledge	Mathematics I
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name further concepts in analysis and linear algebra. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in analysis and linear algebra with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112
Credit points	8
Course achievement	Compulsory: Yes; Bonus: 10 %; Form: Excercises; Description:
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2976: Mathematics II	
Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2977: Mathematics II	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L2978: Mathematics II	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1803: Engineering Mechanics II (Elastostatics)

Courses

Title	Typ	Hrs/wk	CP
Engineering Mechanics II (Elastostatics) (L0493)	Lecture	2	2
Engineering Mechanics II (Elastostatics) (L1691)	Recitation Section (large)	2	2
Engineering Mechanics II (Elastostatics) (L0494)	Recitation Section (small)	2	2

Module Responsible	Prof. Christian Cyron
Admission Requirements	None
Recommended Previous Knowledge	Engineering Mechanics I, Mathematics I (basic knowledge of rigid body mechanics such as balance of linear and angular momentum, basic knowledge of linear algebra like vector-matrix calculus, basic knowledge of analysis such as differential and integral calculus)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Having accomplished this module, the students know and understand the basic concepts of continuum mechanics and elastostatics, in particular stress, strain, constitutive laws, stretching, bending, torsion, failure analysis, energy methods and stability of structures.
Skills	Having accomplished this module, the students are able to - apply the fundamental concepts of mathematical and mechanical modeling and analysis to problems of their choice - apply the basic methods of elastostatics to problems of engineering, in particular in the design of mechanical structures - to educate themselves about more advanced aspects of elastostatics
Personal Competence	
Social Competence	Ability to communicate complex problems in elastostatics, to work out solution to these problems together with others, and to communicate these solutions
Autonomy	self-discipline and endurance in tackling independently complex challenges in elastostatics; ability to learn also very abstract knowledge
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L0493: Engineering Mechanics II (Elastostatics)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	The lecture Engineering Mechanics II introduces the fundamental concepts of stress and strain and explains how these can be used to characterize and compute elastic deformations of mechanical bodies under loading. The focus of the lecture lies on: • basis of continuum mechanics: stress, strain, constitutive laws • truss • torsion bar • beam theory: bending, moment of inertia of area, transverse shear • energy methods: Maxwell-Betti reciprocal work theorem, Castigliano's second theorem, theorem of Menabrea • strength of materials: maximum principle stress criterion, yield criteria according to Tresca and von Mises • stability of mechanical structures: Euler buckling strut
Literature	• Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 1, Springer • Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2 Elastostatik, Springer

Course L1691: Engineering Mechanics II (Elastostatics)	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron, Dr. Konrad Schneider
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0494: Engineering Mechanics II (Elastostatics)	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Christian Cyron
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1286: Technical Logistics

Courses

Title	Typ	Hrs/wk	CP
Technical Logistics (L1746)	Lecture	3	3
Technical Logistics (L1747)	Recitation Section (small)	2	3

Module Responsible	Prof. Jochen Kreutzfeldt
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of the modules „Introduction into logistics and mobility“, "Technical mechanics 1", "Mathematics 1"
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following skills: 1. The students know technical solutions for solving logistical problems in the areas of warehousing, conveying, sorting, order picking and identifying. 2. The students know approaches to introducing a selected technical solution. 3. The students know practical examples of the presented technical solutions.
Skills	The students will acquire the following skills: 1. The students can select different technical solutions for logistic problems of warehousing, conveying, sorting, order picking and identifying. 2. The students are able to evaluate critically the presented technical solutions with respect to their applicability for different logistical problems and compare different alternatives. 3. The students are able to assess the impact of selected solutions.
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students will be able to sketch technical solutions for solving logistical problems of warehousing, conveying, sorting, order picking and identifying and reflect on their own contribution. 2. The technical solutions from the group are jointly documented and presented. 3. The students are able to present their technical solutions to an audience and they can derive new ideas and improvements from the feedback.
Autonomy	The students will acquire the following competencies: 1. The students are able to sketch autonomously, but under supervision, technical solutions to logistical problems of warehousing, conveying, sorting, order picking and identifying. 2. The students are able to evaluate their technical solutions and discuss the pros and cons.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: No; Bonus: 10 %; Form: Excercises; Description: Bonuspunktaufgaben in Maple
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L1746: Technical Logistics	
Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Jochen Kreutzfeldt
Language	DE
Cycle	SoSe
Content	The lecture gives an introduction in solutions and approaches of technical logistics. Five main topics will be addressed: (1) warehousing (2) conveying (3) sorting (4) order picking (5) identifying For each topic, various technical solutions are presented and discussed under consideration of advantages and disadvantages. This content is supplemented by practical examples that can be complemented by inviting guest lecturers. In the exercises selected technical solutions will be presented and discussed for certain problems and practiced by the students.
Literature	Griemert, Rudolf (2015): Fördertechnik. Auswahl und Berechnung von Elementen und Baugruppen. [S.l.]: Morgan Kaufmann. Hompel, Michael ten; Schmidt, Thorsten; Nagel, Lars (2007): Materialflusssysteme. Förder- und Lagertechnik. 3. Aufl. Berlin: Springer. Hompel, Michael ten; Büchter, Hubert; Franzke, Ulrich (2008): Identifikationssysteme und Automatisierung. [Intralogistik]. Berlin, Heidelberg: Springer. Hompel, Michael ten; Schmidt, Thorsten (2010): Warehouse Management. Organisation und Steuerung von Lager- und Kommissioniersystemen. 4. Aufl. Berlin: Springer. Hompel, Michael ten; Beck, Maria; Sadowsky, Volker (2011): Kommissionierung. Materialflusssysteme 2 - Planung und Berechnung der Kommissionierung in der Logistik. Berlin [u.a.]: Springer. Jodin, Dirk; Hompel, Michael ten (2012): Sortier- und Verteilsysteme. Grundlagen, Aufbau, Berechnung und Realisierung. 2. Aufl. Berlin: Springer. Martin, Heinrich (2014): Transport- und Lagerlogistik. Planung, Struktur, Steuerung und Kosten von Systemen der Intralogistik. 9., vollst. überarb. u. akt. Aufl. 2014. Wiesbaden: Imprint: Springer Vieweg.

Course L1747: Technical Logistics	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jochen Kreutzfeldt
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1681: Technical drawing and CAD

Courses

Title	Typ	Hrs/wk	CP
Introduction to CAD (L2808)	Recitation Section (small)	2	3
Fundamentals of Technical Drawing (L1741)	Lecture	1	1
Fundamentals of Technical Drawing (L1742)	Recitation Section (large)	1	2

Module Responsible	Dr. Marko Hoffmann
Admission Requirements	None
Recommended Previous Knowledge	Basic internship
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students will learn how to generate technical drawing/create technical drawings according to norms • Students will become acquainted with the various types of views in drawings (procection methods, views, sectional representations) • Students will learn how to insert the dimensions in technical drawings • Students will acquire the skills to render data in detailed drawings according to norms (e.g. tolerance dimensioning, fits and surface specifications) • Use of a CAD system for the 3D design of simple and more complex components • Perfom dimensions using a CAD system, creation of assemblies, creation of technical drawings from the 3D design • Integration of standard parts into the 3D design • Further processing of the 3D design for 3D printing, basic knowledge of the main 3D printing techniques.
Skills	• Students are capable to construct simple technical drawings, considering tolerances and fits. • Students are capable to strengthen the spatial sense. • Students will be able to operate a CAD system and use it to create 3D designs.
Personal Competence	
Social Competence	• Students are able to work together in interdisciplinary basic groups on subject related tasks and small design studies and present their results.
Autonomy	• They work on their homework by their own and get feedback in their particular interdisciplinary basis group to evaluate their actual knowledge. • Students are capable to self-reliantly gather information from subject related, professional publications and relate that information to the context of the lecture, e.g. preparing of technical drawings or choosing of a construction material for applications in the field of logistics and mobility.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 10 % / Subject theoretical and practical work No / 5 % / Excercises
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2808: Introduction to CAD	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	WiSe
Content	• Presentation of a CAD system for the 3D design of simple and more complex components • Perfom dimensions using a CAD system, creation of assemblies, creation of technical drawings from the 3D design • Integration of standard parts into the 3D design • Further processing of the 3D design for 3D printing, basic knowledge of the main 3D printing techniques.
Literature	• Hoischen, Hans; Fritz, Andreas (Hrsg.): "Hoischen/Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie", 35. überarbeitete und aktualisierte Auflage, Cornelsen Verlag, Berlin, 2016. • Fritz, Andreas; Hoischen, Hans; Rund, Wolfgang (Hrsg.): "Praxis des Technischen Zeichnens Metall / Erklärungen, Übungen, Tests", 17. überarbeitete Auflage; Cornelsen Verlag, Berlin, 2016. • Labisch, Susanna; Weber, Christian: "Technisches Zeichnen : Selbstständig lernen und effektiv üben", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2013. • Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen : Grundlagen, Normung, Übungen und Projektaufgaben", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014. • Klein, Martin; Alex, Dieter u.a.; DIN: Deutsches Institut für Normung e.V. (Hrsg.): "Einführung in die DIN-Normen"; 14. neubearbeitete Auflage, Teubner u.a., Stuttgart u.a., 2008.

Course L1741: Fundamentals of Technical Drawing	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	SoSe
Content	• Technical drawing basics (contents, kinds of drawings and generation of drawings according to relevant standards) • Projective geometry (basics, orthographic projections, isometric projections, cuts, developed views, penetration views)
Literature	• Hoischen, Hans; Fritz, Andreas (Hrsg.): "Hoischen/Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie", 35. überarbeitete und aktualisierte Auflage, Cornelsen Verlag, Berlin, 2016. • Fritz, Andreas; Hoischen, Hans; Rund, Wolfgang (Hrsg.): "Praxis des Technischen Zeichnens Metall / Erklärungen, Übungen, Tests", 17. überarbeitete Auflage; Cornelsen Verlag, Berlin, 2016. • Labisch, Susanna; Weber, Christian: "Technisches Zeichnen : Selbstständig lernen und effektiv üben", 4. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2013. • Kurz, Ulrich; Wittel, Herbert: "Böttcher/Forberg Technisches Zeichnen : Grundlagen, Normung, Übungen und Projektaufgaben", 26. überarbeitete und erweiterte Auflage, Springer Vieweg Verlag, Wiesbaden, 2014. • Klein, Martin; Alex, Dieter u.a.; DIN: Deutsches Institut für Normung e.V. (Hrsg.): "Einführung in die DIN-Normen"; 14. neubearbeitete Auflage, Teubner u.a., Stuttgart u.a., 2008.

Course L1742: Fundamentals of Technical Drawing	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marko Hoffmann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1674: Technical Complementary Course for Logistics and Mobility (according to Subject Specific Regulations)

Courses

Title	Typ	Hrs/wk	CP

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Depends on choice of courses
Credit points	6
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Module M1671: Introduction to Economics

Courses

Title	Typ	Hrs/wk	CP
Introduction to Economics (L2712)	Lecture	2	3
Introduction to Economics (L2713)	Recitation Section (large)	2	3

Module Responsible	Prof. Timo Heinrich
Admission Requirements	None
Recommended Previous Knowledge	None.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students know • topics and issues in microeconomics and macroeconomics, • the functioning of a market economy and different market forms, • important economic parameters and • possibilities of economic policy interventions.
Skills	On the basis of the acquired knowledge, students are able to • understand economic models and apply them to economic policy issues, • reduce complex relationships to essential mechanisms and evaluate their practical relevance and • evaluate economic policy decisions and apply basic methods of economic analysis.
Personal Competence	
Social Competence	The students are able to • address the taught content argumentatively and discuss current economic topics, • grasp complex issues and formulate systematic solutions and • recognize the functioning of real markets with their opportunities and risks.
Autonomy	The students are able to • deal with basic economic concepts and independently communicate their own analyses on this basis, as well as • analyze and evaluate micro- and macroeconomic policy measures against the background of the various models.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	60 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2712: Introduction to Economics

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Timo Heinrich
Language	EN
Cycle	WiSe

Content	• Introduction: Ten Principles of Economics
	• Microeconomics:
	  ◦ Theory of the Household
	  ◦ Theory of the Firm
	  ◦ Competitive Markets in Equilibrium
	  ◦ Market Failure: Monopoly and External Effects
	  ◦ Government Policies
	• Macroeconomics:
	  ◦ A Nation's Real Income and Production

Literature	• Mankiw/Taylor: Economics, Cengage, 5th ed., 2020 • The CORE Team: Economy, Society and Public Policy, Oxford University Press, 2019

Course L2713: Introduction to Economics	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Timo Heinrich
Language	EN
Cycle	WiSe
Content	
Literature	

Module M1692: Computer Science for Engineers - Introduction and Overview

Courses

Title	Typ	Hrs/wk	CP
Computer Science for Engineers - Introduction and Overview (L2685)	Lecture	3	3
Computer Science for Engineers - Introduction and Overview (L2686)	Recitation Section (small)	2	3

Module Responsible	Prof. Görschwin Fey
Admission Requirements	None
Recommended Previous Knowledge	Elementary knowledge of programming as taught in the "Introduction to Programming" bridge course or school.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The module provides prospective engineers with an overview of computer science as a discipline and of the fundamentals of programming. The aim is to facilitate the exchange between engineers and computer scientists and to show possibilities and limitations of programmable systems. Basic knowledge is learned about • approaches for estimating runtime and memory requirements • computer architecture • automata theory • simple data structures like lists and fields • sorting algorithms • programming • modeling for software • unit testing testing and debugging
Skills	Basic programming skills are learned. Students can • describe basic components of a computer • select appropriate data structures for a problem solution • design and implement simple programs • apply unit testing • estimate the runtime and memory requirements of simple algorithms
Personal Competence	
Social Competence	Students are able to develop and communicate computer science solutions in small multidisciplinary project teams.
Autonomy	Students can independently create small programs to solve simple problems and validate their correctness.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 10 % / Attestation / Testate finden semesterbegleitend statt.
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Core Qualification: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2685: Computer Science for Engineers - Introduction and Overview

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Görschwin Fey
Language	DE/EN
Cycle	WiSe
Content	

Literature	• Informatik
	  ◦ Helmut Herold, Bruno Lurz, Jürgen Wohlrab, Matthias Hopf: Grundlagen der Informatik, 3. Auflage, 816 Seiten, Pearson Studium, 2017.
	• C++
	  ◦ Bjarne Stroustrup, Einführung in die Programmierung mit C++, 479 Seiten, Pearson Studium, 2010.
	  --> in der englischen Version bereits eine neuere Auflage!
	  ◦ Jürgen Wolf : Grundkurs C++: C++-Programmierung verständlich erklärt, Rheinwerk Computing, 3. Auflage, 2016.

Course L2686: Computer Science for Engineers - Introduction and Overview	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Görschwin Fey
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1887: Transportation Planning and Traffic Engineering

Courses

Title	Typ	Hrs/wk	CP
Transport Planning and Traffic Engineering (L0997)	Project-/problem-based Learning	4	6

Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to • understand the facts, contexts and objectives of transport planning. • correctly apply definitions and concepts of transport planning. • reproduce basic concepts of transport modelling. • explain the fundamentals of traffic engineering and transport infrastructure construction.
Skills	Students are able to • analyse transport supply based on key metrics. • estimate transport demand using key metrics. • design transport networks, links and junctions. • calculate traffic signal plans. • assess transport concepts.
Personal Competence	
Social Competence	Students are able to • get together in groups and constructively discuss and analyse set problems. • in a group agree on solutions and document them.
Autonomy	Students are able to • produce reports on group work. • structure the tasks and timing for working out a set problem.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory: No; Bonus: 5 %; Form: Excercises; Description:
Examination	Subject theoretical and practical work
Examination duration and scale	Project report in four work packages, in small groups, during the semester
Assignment for the Following Curricula	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L0997: Transport Planning and Traffic Engineering	
Typ	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	WiSe
Content	The course provides an introductory overview over the fundamentals of urban and regional transport planning, including the sub-topic traffic engineering. The following subject areas are covered: • objectives of transport planning, • key mobility metrics, • measuring and predicting demand, • designing and planning transport infrastructure, • fundamentals of traffic engineering and • an introduction to transport concepts and planning processes.
Literature	Bosserhoff, Dietmar (2000) Integration von Verkehrsplanung und räumlicher Planung. Schriftenreihe der Hessischen Straßen- und Verkehrsverwaltung, Heft 42. Hessisches Landesamt für Straßen- und Verkehrswesen. Wiesbaden. Lohse, Dieter; Schnabel, Werner (2011) Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung: Band 1; Straßenverkehrstechnik. Beuth Verlag. Berlin. Forschungsgesellschaft für Straßen- und Verkehrswesen (2006) Richtlinien für die Anlage von Stadtstraßen - RASt 06. FGSV-Verlag. Köln (FGSV, 200). Vallée, Dirk; Engel, Barbara; Vogt, Walter (2021) Stadtverkehrsplanung Band 3, Springer Verlag. Berlin.

Module M1740: Project Management and Accounting

Courses

Title	Typ	Hrs/wk	CP
Foundations of cost and activity accounting (L2832)	Lecture	2	3
Foundations of project management (L2831)	Lecture	2	3

Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
Recommended Previous Knowledge	No previous experience required.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students know... • common procedure models for project management. • forms of project organization. • success factors in project management. • Types of project controlling. • strategies for risk analysis and avoidance.
Skills	Students are able to... • independently deal with a new project and divide it into appropriate work packages. • manage and control a project during its execution. • react appropriately in case of project risks. • analyze strategic issues and interpret and present the results.
Personal Competence	
Social Competence	The students can... • solve complex tasks in a team and document them accordingly. • perform different roles during teamwork and give themselves appropriate feedback within the team. • present and represent the relevant results of their work in front of experts.
Autonomy	Students are able to... • independently obtain necessary information for planning a project. • to structure themselves and their project over a longer period of time. • to analyze the progress of the project independently and to intervene in a controlling manner.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2832: Foundations of cost and activity accounting

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Matthias Meyer
Language	DE
Cycle	WiSe
Content	
Literature	

Course L2831: Foundations of project management	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Ann-Kathrin Lange
Language	DE
Cycle	WiSe
Content	In this lecture the contents of the project management are explained. The technical contents are accompanied by a continuous exercise to deepen the methods and to promote independent work. The students learn the most important contents of the different phases of a project.
Literature	Deutschen Gesellschaft für Projektmanagement e. V. (GPM 2019), Kompetenzbasiertes Projektmanagement (PM4) PMI 2017, A Guide to the Project Management Body of Knowledge(PMBoK Guide®) Patzak und Rattay (2018), Projektmanagement - Projekte, Projektportfolios, Programme und projektorientierte Unternehmen Timingers (2017), Modernes Projektmanagement

Module M0831: Introduction to Operations Research and Statistics

Courses

Title	Typ	Hrs/wk	CP
Introduction to Operations Research (L0884)	Lecture	2	2
Introduction to Statistics (L0883)	Lecture	2	2
Exercises to Introduction in Quantitative Methods in Logistics (L0885)	Recitation Section (small)	2	2

Module Responsible	Prof. Kathrin Fischer
Admission Requirements	None
Recommended Previous Knowledge	Knowledge from Mathematics Lectures.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students know • different methods from the field of descriptive statistics and can explain them and their importance for Logistics; • selected discrete and continuous distribution functions and can explain their meaning and their areas of application; • the laws of probability theory and can explain them; • different methods of inferential statistics - e.g. confidence intervals, hypothesis testing; • the history and relevance of Operations Research; • linear programming methods for solving planning problems; • selected methods of transportation and network optimization, e.g. methods for finding a shortest path; • models and methods for the travelling salesman and the vehicle routing problem; • appropriate software for solving these problems.
Skills	Students are able to • collect data by appropriate methods, to aggregate, classify and analyze the data and to illustrate their results; • recognize different distribution functions and to apply them in the solution of Logistics problems; • apply laws of probability to construct solutions for Business problems; • use appropriate methods of inferential statistics, apply them to Business problems and evaluate the results of their analysis; • construct appropriate quantitative - linear or integer - models for Business planning situations; • apply methods from linear programming and interpret the results; • apply methods from transport and network planning and interpretthe results; • solve TSPs and vehicle routing problems by heuristic methods; • carry out a sensitivity analysis and evaluate the results; • critically judge the different methods and their applicability; • apply appropriate software for solving the problems.
Personal Competence	
Social Competence	Students are able to • work successfully and respectfully in a team, derive group results and document them; • engage in scientific discussions on topics from the fields of Statistics and OR; • present the results of their work to others in an understandable way.
Autonomy	Students are able to • carry out data analyses for given tasks independently, individually or in a team; • solve complex Business planning problems independently or in a team, selecting and using appropriate software; • gather knowledge in the area independently and to apply their knowledge in problem solving; • critically reflect on the results of their work.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	2 hours
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L0884: Introduction to Operations Research	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kathrin Fischer
Language	DE
Cycle	SoSe
Content	1. Introduction to Operations Research 2. Linear Programming and Applications 3. Transportation Problems 4. Network Problems (e.g. Shortest Paths) 5. Travelling Salesman Problems and Vehicle Routing
Literature	D.R. Anderson / D.J. Sweeney / T.A. Williams / Martin: Quantitative Methods for Business. 11th Edition, Thomson, South Western 2008. W. Domschke / A. Drexl: Einführung in Operations Research, 7. Auflage, Springer, Berlin et al. 2007. F.S. Hillier/ G.J. Lieberman: Introduction to Operations Research. 8th Edition, McGraw-Hill, 2005. L. Suhl / T. Mellouli: Optimierungssysteme. Springer Verlag. Berlin et al. 2006.

Course L0883: Introduction to Statistics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kathrin Fischer
Language	DE
Cycle	SoSe
Content	1. Introduction to statistics 2. Basics of descriptive statistics 3. Methods of descriptive statistics 4. Probabilities 5. Discrete probability distrbutions and their applications 6. Continuous probability distrbutions and their application 7. Introduction to confidence intervals 8. Introduction to hypothesis testing 9. Linear regression
Literature	Bluman, Alan G.: Elementary Statistics - A brief version. Third Edition, McGrawHill 2006. Bowerman, Bruce L. and O'Connell, Richard T.: Business Statistics in Practice, 4 th edition, McGraw-Hill 2007. Fahrmeir, L., Künstler, R., Pigeot, I., Tutz, G.: Statistik - Der Weg zur Datenanalyse. 6. Auflage. Berlin, Heidelberg 2007. Quatember, A.: Statistik ohne Angst vor Formeln. 2. Auflage. Pearson Verlag 2008. Schira, J.: Statistische Methoden der VWL und BWL - Theorie und Praxis. 2. Auflage, Pearson Verlag 2005.

Course L0885: Exercises to Introduction in Quantitative Methods in Logistics	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kathrin Fischer
Language	DE
Cycle	SoSe
Content	Interactive sessions for discussion and application of the contents of "Introduction to Statistics" and "Introduction to OR".
Literature	Literaturangaben siehe Vorlesungen Übungsblätter und weitere Informationen werden in der Übung verteilt.

Module M1261: Management

Courses

Title	Typ	Hrs/wk	CP
Finance and Investment (L1707)	Lecture	2	3
Foundations of Management (L1706)	Lecture	2	3

Module Responsible	Prof. Thomas Wrona
Admission Requirements	None
Recommended Previous Knowledge	Basics of business studies
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students will accumulate extensive knowledge about different aspects of management after having participated in this module. • Students are able to give an overview of the activities of management and describe processes and content of management. • Students are able to identify the features and procedures by which a modern organization can be managed. • Students are able to explain and analyze relationships between management activities. • Students are able to describe and apply methods of finance and accounting. Students are able to develop procedures and basic approaches in the context of investment and financing decisions for the company.
Skills	• The students are able to recognize and evaluate important skills for management. • The students are able to develop their own understanding of successful leadership in organizations and evaluate strategies accordingly. • The Students are able to differentiate between different environmental contingencies and asses the underlying risk potentials. Students are able to utilize models and methods of accounting and apply it from a business perspective.
Personal Competence	
Social Competence	After attending the module students will be able to • lead and take part in strategy-related discussions • present results, both in written and verbal form work respectful with others in a team.
Autonomy	The students are able to gather, analyze, and critically reflect on information and data and convert it into manageable summaries.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L1707: Finance and Investment

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ulrich Pape
Language	DE
Cycle	SoSe
Content	Introduction to the theory and practice of finance and accounting: The focus will be on basic principles of capital budgeting, finance and accounting and the underlying various methods of accounting.
Literature	Wird zu Veranstaltungsbeginn bekannt gegeben.

Course L1706: Foundations of Management

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Thomas Wrona
Language	DE
Cycle	SoSe
Content	Introduction to the theory and practice of management: The fundamentals of corporate governance will be taught, as well as an in-depth perspective on activities, characteristics and methods of management.
Literature	Wird zum Veranstaltungsbeginn bekannt gegeben.

Module M1672: IT applications for logistics and mobility

Courses

Title	Typ	Hrs/wk	CP
Introduction to Geoinformation Science (L2465)	Project-/problem-based Learning	3	3
IT applications for logistics and mobility (L2827)	Lecture	1	1
IT applications for logistics and mobility (L2828)	Recitation Section (small)	2	2

Module Responsible	Dr. Jutta Wolff
Admission Requirements	None
Recommended Previous Knowledge	Introduction to logistics and mobility
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students acquire the following knowledge: • The students know the basic types of IT systems in logistics. • The students know different techniques for business process modeling. • The students know technological solutions for communication and identification in logistics.
Skills	The students acquire the following specialist skills: • The students can describe and evaluate basic IT processes in logistics. • The students can basically operate various IT systems in logistics. • The students can describe and evaluate the differences between different basic technologies.
Personal Competence	
Social Competence	The students acquire the following social skills: • The students are able to explain the basic principles of information technology to other students. • The students can help other students to find errors in process modeling. • The students are able to present their results in front of an audience.
Autonomy	The students acquire the following skills: • The students familiarize themselves independently with unknown IT systems. • The students are able to independently find a suitable modeling technique for a process. • Based on the given task, the students can design a simple application in a basic technology.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2465: Introduction to Geoinformation Science

Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Yohannis Tadesse
Language	DE
Cycle	SoSe
Content	• Theoretical basics of Geo-Information-Systems • Data models, geographical coordinates, geo-referencing, map-views • Data mining and -analyses of geo-data • Analysis techniques
Literature	

Course L2827: IT applications for logistics and mobility	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jutta Wolff
Language	DE
Cycle	SoSe
Content	The course covers the basics of information technology in relation to logistics systems. The course is divided into five subject areas: (1) Planning of IT systems in logistics, (2) data acquisition systems, (3) communication systems, (4) IT-supported processing, (5) basic technological developments in information technology. The course consists of a basic lecture with connected exercise units.
Literature	Becker, J.; Mathas, C.; Winkelmann, A. (2009): Geschäftsprozessmanagement. Berlin [u. a.]: Springer Finkenzeller, K.; Gebhart, M. (2015): RFID-Handbuch. Grundlagen und praktische Anwendungen von Transpondern, kontaktlosen Chipkarten und NFC. 7. Auflage, München: Hanser Hausladen, I. (2016): IT-gestützte Logistik.3. akt. und erw. Auflage, Wiesbaden: Springer-Gabler Pfohl, H.-C. (2018): Logistiksysteme. Betriebswirtschaftliche Grundlagen. 9. Auflage, Berlin, Heidelberg: Springer Vieweg ten Hompel, M.; Schmidt, T.; Dregger, J. (2018): Materialflusssysteme. Förder- und Lagertechnik. 4. Auflage, Berlin [u. a.]: Springer Vieweg (VDI-Buch). ten Hompel, M.; Wolf, O.; Nettsträter, A.; Ebel, D.; Geissen, T.; Kraft, V.; Mertens, C.; Pott, C.; Schoneboom, J.; Witthaut, M. (2013): IT in der Logistik 2013/2014. Stuttgart: Fraunhofer-Verlag

Course L2828: IT applications for logistics and mobility	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jutta Wolff
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1735: Ethics and Technology - Responsible Innovation

Courses

Title	Typ	Hrs/wk	CP
Ethics and Technology - Responsible Innovation (L2830)	Lecture	4	4

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Credit points	4
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	noch zu definieren
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L2830: Ethics and Technology - Responsible Innovation

Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	NN
Language	DE
Cycle	WiSe
Content	
Literature	

Module M1704: Gamification of Strategic Thinking

Courses

Title	Typ	Hrs/wk	CP
Gamification of Strategic Thinking (L2708)	Seminar	4	6

Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• recognize and analyze relationships and interdependencies between different strategic decision areas • understand problem-related terms, theories and methods of business administration and relate these to practical situations
Skills	• make well-founded decisions in realistic settings by drawing on the business administration knowledge • consider in parallel and balance several relevant factors when making business-related decisions (e.g. financial situation, behavior of competitors, production capacities) • critically analyze decisions in hindsight and deduce consequences for future decisions from this analysis • analyze and explain economic and strategic phenomena by drawing on business administration theories and methods
Personal Competence	
Social Competence	• form stable work groups with fellow students, even those, who were previously unknown, and agree on work habits • arrive at a consensus as a team when making management decisions and, if necessary, to solve conflicts along the way to achieving the consensus • adequately present the situation of a (fictitious) organization and their decision making to teachers and fellow students
Autonomy	• make and justify decisions in simulated professional situations • reflect their own actions in hindsight and arrive at suggestions for improvements in a structured way • critically depict and reflect situations in a structured way, both, orally as well as in written reports • make transfers from theory into practice
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Different achievements (single/team) - learning diary, presentations, reflections, essay
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Elective Compulsory

Course L2708: Gamification of Strategic Thinking

Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Matthias Meyer, Thorsten Kodalle
Language	DE
Cycle	WiSe
Content	The seminar "Gamification of Strategic Thinking" is offered as part of the elective course of studies "Logistics and Mobility" and currently offers space for 25 students. In cooperation with the German Armed Forces Command and Staff College, the seminar aims to teach strategic methods within the framework of a wargaming approach. For this purpose, the course consists of two blocks, which take place parallel to each other throughout the semester. In the theoretical block, students are taught the basics of various methods for strategy development and management (including SWOT analysis, SCRUM or Kanban). In the second block, the students apply the methods they have learned on the basis of the board game "Sycthe". For this, the students are divided into five groups with five members each. Each of these groups plays a "party" of the board game and is supposed to develop a strategy with the help of the learned methods that helps the respective team to win. Afterwards, the experiences will be reflected upon by means of a written elaboration and a proposal for an own business wargame will be developed.
Literature	Green, K. C. (2005), "Game theory, simulated interaction, and unaided judgment for forecasting decisions in conflicts," International Journal of Forecasting, 21, 463-472. Romeike. F., Spitzner, J. (2013): Von Szenarioanalyse bis Wargaming, Betriebswirtschaftliche Simulationen im Praxiseinsatz, Wiley-VCH Sabin, P. (2012), Simulating War - Studying Conflict through Simulation Games, Part 1, Bloomsbury Press, London.

Module M0622: Business Administration and Enterprise Resource Planning: CERMEDES AG

Courses

Title	Typ	Hrs/wk	CP
Business Administration and Enterprise Resource Planning: CERMEDES AG (L0330)	Seminar	2	3
Business Administration and Enterprise Resource Planning: CERMEDES AG (L1785)	Lecture	2	3

Module Responsible	Prof. Christian Ringle
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge in business administration.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to... • describe an internationally active company; • describe complex and interrelated business processes along the supply chain; • present important aspects of the project management of enterprise resource planning software implementations; • name rules and processes for the implementation of business processes in SAP; • explain the functioning and use of enterprise resource planning software along the supply chain; • conduct business processes in SAP on their own; • present the integrative role of enterprise resource planning systems.
Skills	The students are able to... • map the design of business processes along the supply chain of a firm; • implement business processes in an enterprise resource planning software; • use an internationally used enterprise resource planning software in a daily routine; • critically evaluate the enterprise resource planning software along the theoretical requirements for optimally designing a business process.
Personal Competence	
Social Competence	The students are able to... • direct fruitful and professional discussions; • work in teams on exercises; • present and defend results of their work; • communicate and collaborate successfully and respectfully with others in teams.
Autonomy	The students will be able to acquire knowledge in a specific context independently and to map this knowledge onto other new complex problem fields.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Case studies, Mini-Challenges, Presentations
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Elective Compulsory

Course L0330: Business Administration and Enterprise Resource Planning: CERMEDES AG	
Typ	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Ringle
Language	EN
Cycle	WiSe
Content	The course involves two main parts: During the first part of the course, participants are provided with insights into the market for ERP-Software and are provided with knowledge on how ERP-implementation projects proceed and how these projects should ideally be managed from a theoretical and practical perspective. In addition, participants are provided with an understanding of business functions and processes by means of visiting the TUHH model factory. In the model factory, participants and are solving special business cases on the basis of group-specific tasks. Finally, participants are introduced into the basic functioning of ERP-Software referring to the most common system (SAP). Participants gain a basic understanding of implementing organizational data, master data and processes into the system. During the second phase of this course, the students work independently in groups on deepening challenges, which conceptually build up on the executed case studies from phase one. Using the knowledge from phase one, the students are able to transfer the theoretical knowledge on the practical execution of the challes in SAP. The results of the group work will be presented in phase two.
Literature	Participants will be provided with a course handout in the form of ppt.-slides which can be downloaded in advance. Further literature references regarding the theoretical concepts are not provided (as this is part of the challenge in writing the thesis); literature references with regard to the ERP-System used are as follows: • Agrawal, A. (2009): Customizing Materials Management Processes in SAP ERP Operations, Galileo Press: Boston. • Arif, N./Tauseef, S. (2010): Integrating SAP ERP Financials, Galileo Press: Boston. • Chudy, M./Castedo, L. (2015): Sales and Distribution in SAP ERP - Practical Guide, Galileo Press: Boston. • Dickersback, J. T./Keller, G. (2010): Production Planning and Control with SAP ERP, 2e, Galileo Press: Boston. • Franz, M. (2014): Project Management with SAP Project System, 4e, Galileo Press: Boston. • Hoppe, M./Gulyassy, F. (2009): Materials Planning with SAP, Galileo Press: Boston. • Veeriah, N. (2011): Customizing Financial Accounting in SAP, Galileo Press: Boston. • Veeriah, N. (2011): Financial Accounting in SAP, Galileo Press: Boston.

Course L1785: Business Administration and Enterprise Resource Planning: CERMEDES AG	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Ringle
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0681: Project Course Logistics and Mobility

Courses

Title	Typ	Hrs/wk	CP

Module Responsible	Dozenten des Studiengangs
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students will receive in-depth knowledge and in-depth skills in a special area of business administration, engineering science, logistics or mobility and can reproduce this knowledge.
Skills	After the project work in a business, engineering related, logistics and or mobility related research field, students are able to... • familiarize themselves with a scientific and/or application-oriented problem • analyze the problem and find a solution (if appropriate as part of a team) • to refer to appropriate literature for the work on a problem as well as to critically evaluate publications • produce a scientifically sound written report on the problem in question (if appropriate as part of a team)
Personal Competence	
Social Competence	After the project work students are able to... • work respectfully in teams and to organize themselves in teams • analyse a problem in a team and to find a solution together • present and defend their project work to a sizable (expert) audience
Autonomy	After the project work students are able to... • familiarize themselves successfully with a demanding scientific or application oriented problem independently • prepare and deliver a presentation of their results independently
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Course achievement	None
Examination	Study work
Examination duration and scale	
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Elective Compulsory

Module M1911: Project Seminar WILUM

Courses

Title	Typ	Hrs/wk	CP
Project Seminar WILUM (L3153)	Seminar	3	6

Module Responsible	Dozenten des SD W
Admission Requirements	None
Recommended Previous Knowledge	Prior knowledge in the relevant area from the relevant Management modules.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	Students are able to • independently acquire the relevant knowledge to handle their project • independently carry out a (pre-defined) complex research task and/or solve a complex problem • select and use the relevant literature and critically evaluate it • aggregate their knowledge and results and present it to others • write a scientific report on the project / problem at hand, individually or in a team.
Personal Competence	
Social Competence	Students are able to • work respectfully and successfully in a team, organize the team, and solve complex tasks in a team in a given timeframe • analyse a problem in a team and develop a solution for the problem • present the results of their work to specialists.
Autonomy	Students are able to • define the scope of their project • independently acquire relevant scientific knowledge • independently carry out a (pre-defined) complex research task • independently prepare a presentation of the relevant aspects of the project.
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	To be announced in seminar.
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Core Qualification: Elective Compulsory

Course L3153: Project Seminar WILUM

Typ	Seminar
Hrs/wk	3
CP	6
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Lecturer	Prof. Heike Flämig
Language	DE/EN
Cycle	WiSe/SoSe
Content	Contents differ, depending on the institute which organizes the respective seminar. Topics are always announced at the start of the term.
Literature	Wird je nach Thema angegeben; in der Regel handelt es sich um wissenschaftliche Fachartikel und Publikationen, vorwiegend in englischer Sprache.

Module M1889: Innovation and product development - a business game

Courses

Title	Typ	Hrs/wk	CP
Innovation and product development - a business game (L3126)	Project-/problem-based Learning	4	6

Module Responsible	Prof. Tim Schweisfurth
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Different achievements (single/team) - learning diary, presentations, reflections, essay
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Core Qualification: Elective Compulsory

Course L3126: Innovation and product development - a business game

Typ	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Tim Schweisfurth, Prof. Moritz Göldner
Language	EN
Cycle	SoSe
Content	
Literature	

Module M1675: Legal Foundations of Logistics and Mobility

Courses

Title	Typ	Hrs/wk	CP
Legal Foundations of Transportation and Logistics (L1186)	Lecture	2	2
Legal Foundations of Transportation and Logistics (L1187)	Recitation Section (large)	1	2

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • describe the systematics of transport law and logistics law • explain the legal connections in transport and logistics
Skills	Students can... • analyze and solve questions of law for transport and logistics • discuss and systematically evaluate law cases and verify them with applicable laws
Personal Competence	
Social Competence	Students can come to results in groups and document them.
Autonomy	Students can... • develop systematical thinking • search and analyze laws independently • answer questions of law concerning transport and logistics independently
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Credit points	4
Course achievement	None
Examination	Written exam
Examination duration and scale	60 min
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory

Course L1186: Legal Foundations of Transportation and Logistics

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Niels Witt
Language	DE
Cycle	SoSe
Content	• Basics of german law • regulations of the HGB • international conventions • maritime trade law • contract logistics • complex logistics chains
Literature	Aktueller Text des Bürgerlichen Gesetzbuches und Handelsgesetzbuches

Course L1187: Legal Foundations of Transportation and Logistics

Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Niels Witt
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0974: Business Simulation Marktstrat

Courses

Title	Typ	Hrs/wk	CP
Business Simulation Marktstrat (L0918)	Seminar	4	6

Module Responsible	Prof. Christian Lüthje
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • recognize and analyze relationships and interdependencies between different decision areas in business management • understand problem-related terms, theories and methods of business administration and relate these to practical situations in businesses
Skills	Students are able to... • make well-founded decisions in realistic coroporate settings by drawing on the business administration knowledge • consider in parallel and balance several relevant factors when making business-related decisions (e.g. financial situation, behavior of competitors, market demand, production capacities) • critically analyze business decisions in hindsight and deduce consequences for future decisions from this analysis • analyze and explain phenomena from daily business by drawing on business administration theories and methods
Personal Competence	
Social Competence	Students are able to... • form stable work groups with fellow students, even those, who were previously unknown, and agree on work habits • arrive at a consensus as a team when making management decisions and, if necessary, to solve conflicts along the way to achieving the consensus • adequately present the situation of a (fictitious) company and their decision making to teachers and fellow students
Autonomy	Students are able to... • make and justify decisions in simulated professional situations • reflect their own actions in hindsight and arrive at suggestions for improvements in a structured way • critically depict and reflect situations in a structured way, both, orally as well as in written reports • make transfers from theory into practice
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	different achievements (single/team) - learning diary, presentations, reflections
Assignment for the Following Curricula	Logistics and Mobility: Core Qualification: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Core Qualification: Elective Compulsory

Course L0918: Business Simulation Marktstrat	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	The business simulation game Markstrat B2B - Markstrat is a business simulation which puts you into the role of managing the marketing division of the electro-mechanical business unit of a large corporation. Competing with several other companies, you try to successfully market two products to business customers. To this end, you and other students jointly develop and implement a long-term marketing strategy for your business unit. During the 10 rounds of the simulation game, the students and the randomly assigned student team make decisions in the areas of product development, advertising, sales, price, production, and human resources on a weekly basis. To make well-informed decisions, the student teams can draw on a large number of information sources such as customer surveys, experiments, market studies, and benchmarks which you need to analyze during each round of the simulation. The simulation is accompanied by a comprehensive introduction, a concomitant coaching, as well as a mid-term and final presentation. In addition, the student teams will prepare a written report.
Literature	Kotler, Philip und Keller, Kevin Lane (2011): Marketing Management, 14th Edition, Prentice Hall International Morris, Michael H.; Pitt, Leyland F.; Honeycutt Jr., Earl D. (2001): Business-To-Business Marketing: A Strategic Approach, 3rd Edition, Sage Bruhn, Manfred (2012): Marketing - Grundlagen für Studium und Praxis, 11. Auflage, Gabler

Specialization Information Technology

Module M1897: New Technologies and Markets

Courses

Title	Typ	Hrs/wk	CP
Data-driven marketing and sales (L3138)	Lecture	3	4
New technologies and market opportunities (L3139)	Project-/problem-based Learning	1	2

Module Responsible	Prof. Christian Lüthje
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Written elaboration, exercises, presentation, oral participation
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L3138: Data-driven marketing and sales

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	
Literature	

Course L3139: New technologies and market opportunities

Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	
Literature	

Module M1693: Computer Science for Engineers - Programming Concepts, Data Handling & Communication

Courses

Title	Typ	Hrs/wk	CP
Computer Science for Engineers - Programming Concepts, Data Handling & Communication (L2689)	Lecture	3	3
Computer Science for Engineers - Programming Concepts, Data Handling & Communication (L2690)	Recitation Section (small)	2	3

Module Responsible	Prof. Sibylle Fröschle
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: No; Bonus: 10 %; Form: Attestation; Description: Testate finden semesterbegleitend statt.
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Green Technologies, Focus Renewable Energy: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Systems / Renewable Energies: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Medical Engineering: Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Mechatronics: Specialisation Electrical Systems: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory

Course L2689: Computer Science for Engineers - Programming Concepts, Data Handling & Communication

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Sibylle Fröschle
Language	DE
Cycle	SoSe
Content	
Literature	John V. Guttag: Introduction to Computation and Programming Using Python. With Application to Understanding Data. 2nd Edition. The MIT Press, 2016.

Course L2690: Computer Science for Engineers - Programming Concepts, Data Handling & Communication	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Sibylle Fröschle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0610: Electrical Machines and Actuators

Courses

Title	Typ	Hrs/wk	CP
Electrical Machines and Actuators (L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2

Module Responsible	Prof. Thorsten Kern
Admission Requirements	None
Recommended Previous Knowledge	Basics of mathematics, in particular complexe numbers, integrals, differentials Basics of electrical engineering and mechanical engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can to draw and explain the basic principles of electric and magnetic fields. They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the driven engine.
Skills	Students are able to calculate two-dimensional electric and magnetic fields in particular ferromagnetic circuits with air gap. For this they apply the usual methods of the design auf electric machines. They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.
Personal Competence	
Social Competence	none
Autonomy	Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse independently the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantities and characteristic curves.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Design of four machines and actuators, review of design files
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Specialisation Electrical Engineering: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Elective Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Electrical Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0293: Electrical Machines and Actuators	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation, Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands´diagram), torque vs. speed characteristics, rotor layout (squirrel-cage vs. sliprings), Drives with variable speed, inverter fed operation, special drives
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"

Course L0294: Electrical Machines and Actuators	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0594: Fundamentals of Mechanical Engineering Design

Courses

Title	Typ	Hrs/wk	CP
Fundamentals of Mechanical Engineering Design (L0258)	Lecture	2	3
Fundamentals of Mechanical Engineering Design (L0259)	Recitation Section (large)	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	• Basic knowledge about mechanics and production engineering • Internship (Stage I Practical)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module, students are able to: • explain basic working principles and functions of machine elements, • explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, indicate the background of dimensioning calculations.
Skills	After passing the module, students are able to: • accomplish dimensioning calculations of covered machine elements, • transfer knowledge learned in the module to new requirements and tasks (problem solving skills), • recognize the content of technical drawings and schematic sketches, • technically evaluate basic designs.
Personal Competence	
Social Competence	• Students are able to discuss technical information in the lecture supported by activating methods.
Autonomy	• Students are able to independently deepen their acquired knowledge in exercises. • Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0258: Fundamentals of Mechanical Engineering Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Dr. Nikola Bursac, Prof. Sören Ehlers
Language	DE
Cycle	SoSe

Content	**Lecture**
	• Introduction to design
	• Introduction to the following machine elements
	  ◦ Screws
	  ◦ Shaft-hub joints
	  ◦ Rolling contact bearings
	  ◦ Welding / adhesive / solder joints
	  ◦ Springs
	  ◦ Axes & shafts
	• Presentation of technical objects (technical drawing)
	Exercise
	• Calculation methods for dimensioning the following machine elements:
	  ◦ Screws
	  ◦ Shaft-hub joints
	  ◦ Rolling contact bearings
	  ◦ Welding / adhesive / solder joints
	  ◦ Springs
	  ◦ Axis & shafts

Literature	• Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. • Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. • Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. • Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. • Sowie weitere Bücher zu speziellen Themen

Course L0259: Fundamentals of Mechanical Engineering Design	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Dr. Nikola Bursac, Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1290: Simulation of intra logistics

Courses

Title	Typ	Hrs/wk	CP
Simulation of intra logistics (L1755)	Seminar	4	6

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of the module „Technical Logistics“
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to explain the significance, the structure and the components of an event- and object-oriented simulation model in intralogistics. 2. The students are able to reflect and explain the process of creating and programming an event- and object-oriented simulation model in intralogistics. 3. The students are able to view critically the strengths and weaknesses of event- and object-oriented simulation model.
Skills	The students will acquire the following skills: 1. The students will be able to derive the necessary parameters for the development of an event- and object-oriented simulation model in intralogistics from an existing logistics system. 2. The students will be able to program and run Plant Simulation simulation models independently. 3. The students can evaluate and interpret the results from a simulation model.
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students are able to develop a complex simulation model in a team. 2. The students know the different roles in joint development of a simulation model and can give feedback to their respective roles. 3. The students are able to process the simulation results and present them in front of a audience.
Autonomy	The students will acquire the following independent competencies: 1. The students work independently in an initially unknown software (Plant Simulation). 2. The students are able to derive independently the necessary simulation parameters from information about a logistics system. 3. The students are able to develop and program an event- and object-oriented simulation models from given parameters.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L1755: Simulation of intra logistics	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	NN
Language	DE
Cycle	SoSe
Content	The seminar provides an introduction to the development and programming of event and object-oriented simulation models based on the Plant Simulation software. The simulation models are focused on issues and problems in the field of intralogistics. The seminar will be conducted as a combination of theoretical content and autonomously solving simulation tasks on the computer. The students learn the ideal development workflow, programming and evaluation of a simulation model. Furthermore, the student will become familiar with the standard objects of a simulation model in Plant Simulation and their properties and functions. These standard objects will be used, if necessary with the assistance of the instructor, to build simulation models and analyze and evaluate the results. Furthermore, an introduction to the individual programming of simulation models is given on the basis of Sim Talk language.
Literature	Bangsow, Steffen (2011): Praxishandbuch Plant Simulation und SimTalk, Hanser Verlag, München. Bangsow, Steffen (2015): Tecnomatix plant simulation : modeling and programming by means of examples, Springer, Berlin. Eley, Michael (2012): Simulation in der Logistik : Einführung in die Erstellung ereignisdiskreter Modelle unter Verwendung des Werkzeuges "Plant Simulation", Springer, Berlin.

Module M0852: Graph Theory and Optimization

Courses

Title	Typ	Hrs/wk	CP
Graph Theory and Optimization (L1046)	Lecture	2	3
Graph Theory and Optimization (L1047)	Recitation Section (small)	2	3

Module Responsible	Prof. Anusch Taraz
Admission Requirements	None
Recommended Previous Knowledge	• Discrete Algebraic Structures • Mathematics I
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in Graph Theory and Optimization. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Data Science: Elective Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Data Science: Elective Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L1046: Graph Theory and Optimization	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/EN
Cycle	SoSe
Content	• Graphs, search algorithms for graphs, trees • planar graphs • shortest paths • minimum spanning trees • maximum flow and minimum cut • theorems of Menger, König-Egervary, Hall • NP-complete problems • backtracking and heuristics • linear programming • duality • integer linear programming
Literature	• M. Aigner: Diskrete Mathematik, Vieweg, 2004 • T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Algorithmen - Eine Einführung, Oldenbourg, 2013 • J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007 • A. Steger: Diskrete Strukturen (Band 1), Springer, 2001 • A. Taraz: Diskrete Mathematik, Birkhäuser, 2012 • V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009 • K.-H. Zimmermann: Diskrete Mathematik, BoD, 2006

Course L1047: Graph Theory and Optimization	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1014: Logistics Service Provider Management

Courses

Title	Typ	Hrs/wk	CP
Logistics Service Provider Management (L1240)	Seminar	3	6

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	• Introduction to Logistics and Mobility • Transport and cross-docking Technology • Logistics Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • integrate LSPs into the concept of business logistics • tell the specifics of business services and logistics Services and their derived characteristics • describe logistics functions as LSP service packages • explain, why companies outsource logistics Services and what are actual trends in Business • describe basic outsorucing processes and tender management success factors • describe and analyze intra- and intermodal transport institutions as well as tasks, challenges and opportunities for the Management of LSPs
Skills	Students can... • support the sub-segment specific business functions and management Tasks (e.g. for Road Transport, Airlines, SeaPort Providers etc.) • categorize LSPs regarding strategic product-market-positioning • derive action plans regarding management tasks depending on contigencies
Personal Competence	
Social Competence	Students can... • discuss case studies in Groups (within and outside of the classroom), reaching a common understanding and result • prepare and deliver Business presentations • give and discuss Feedbacks in the large group
Autonomy	Students can... • produce written reports independently
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	2 scientific written papers of approx. 20 pages each. Presentation (approx. 15 pages) with 20-minute closing lecture in groups of 3 to max. 5 persons. Grading of 4 partial grades of 25% each (2 seminar papers, 2 presentation documents) individually per group member.
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1240: Logistics Service Provider Management	
Typ	Seminar
Hrs/wk	3
CP	6
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Lecturer	Prof. Stephan Freichel
Language	DE
Cycle	SoSe
Content	**1 Concept and Functions** Define the role of logistics services providers in the overall concept and functions of logistics services providers. Workshop on the role of logistics services providers in the economy, based on up-to-date topics in the field and in the news. **2 Outsourcing and Cooperation** Make or buy, forms and management of inter-organizational relations **3 Institutions** Special business management features of carriers, haulage contractors, CEP services **4 Trends, Strategies and Management Functions** Market trends, requirements, basic business management and management functions (operations, business development, HR, IT, finance/planning and control, organization, leadership) **5 Strategic Developments and Case Studies** Selected aspects (e.g. risk and innovation management, global and regional networking, greenwashing and sustainability) Examples: Case Study A) Types of company (such as haulage contractors, railway operators, road transport companies, heavy goods, textile and refrigerated goods specialists, CEPs, etc) will be introduced and discussed in the context of a presentation. Case Study B) Individual companies will be analyzed on the basis of accessible material such as company reports, websites and possibly telephone interviews and case studies will be explained and discussed with regard to the functions of the logistics services provider and the management task of the corporate managements of the selected cases.
Literature	Pfohl, H.-Chr.: Logistiksysteme. Betriebswirtschaftliche Grundlagen. 8., neu bearbeite und aktualisierte Auflage, Berlin u.a. 2009 Eßig, M. / Hofmann, E. / Stölzle, W.: Supply Chain Management. München 2013. Freichel, S.L.K.: Organisation von Logistikservice-Netzwerken. Reihe: Logistik und Unternehmensführung, hrsg. von Prof. Dr. H.-Chr. Pfohl, Bd. 4. Berlin 1993. Aberle, G.: Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 4. überarbeitete und erweiterte Auflage, München/Wien 2006. Buchholz, J./Clausen, U./Vastag, A. (Hrsg): Handbuch der Verkehrslogistik, Heidelberg 1998. Corsten, H.: Dienstleistungsmanagement, 3. Auflage, München 1997. Müller-Daupert, B. (Hrsg.): Logistik-Outsourcing, 2. Auflage, München, Vogel, 2009 Ihde, G. B.: Transport, Verkehr, Logistik. Gesamtwirtschaftliche Aspekte und einzelwirtschaftliche Handhabung, 3. völlig überarb. und erw. Auflage, München 2001. van Suntum, U.: Verkehrspolitik, München 1986.

Module M1680: Automation in logistics

Courses

Title	Typ	Hrs/wk	CP
Automation in logistics - Lab (L2913)	Project-/problem-based Learning	2	2
Automation in logistics - seminar (L2688)	Seminar	2	4

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	"Technical logistics" successfully completed "Computer Science for Engineers - Introduction and Overview" successfully completed
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	1. The students know the basic principles of measurement and control technology. 2. The students know localization and navigation solutions used in mobile robotics. 3. The students know automation solutions for storage and order picking. 4. The students can developed and implement basic programs with a programmable logic controller.
Skills	1. The students can describe and evaluate basic control loops. 2. The students can carry out algorithms for localization and navigation. 3. The Students can evaluate the performance of automated storage and picking solutions.
Personal Competence	
Social Competence	1. The students are able to explain the basic principles of measurement and control technology to other students. 2. The students can help other students to find algorithmic errors in localization and navigation algorithms. 3. The students are able to present their results in front of an audience.
Autonomy	1. The students familiarize themselves independently with unknown algorithms. 2. The students are able to independently find a suitable automation approach for a problem. 3. Based on the given task, the students can design an appropriate automation solution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6

Course achievement	Compulsory	Bonus	Form	Description
	Yes	10 %	Attestation	Programmieraufgaben in SPS

Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L2913: Automation in logistics - Lab

Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Introduction to programmable logic controllers (PLC) with CodeSys PLC basics with function blocks and structured text Integration of sensors and actuators Testing of PLC programs in a simulation Transfer of own PLC programs to real control hardware
Literature	Wellenreuther, Günter; Zastrow, Dieter (2016): Automatisieren mit SPS - Übersichten und Übungsaufgaben. Von Grundverknüpfungen bis Ablaufsteuerungen, Wortverarbeitungen und Regelungen, Programmieren mit STEP 7 und CoDeSys, Beispiele, Lernaufgaben, Kontrollaufgaben, Lösungen. 7. Auflage. Wiesbaden: Springer Vieweg (Lehrbuch).

Course L2688: Automation in logistics - seminar	
Typ	Seminar
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	(1) Measurement and sensor technology (2) Basics of control theory (3) Autonomous Mobile Robots (4) Automated storage systems (5) Robotics in order picking.
Literature	Heinrich, Berthold (2019): Grundlagen Regelungstechnik. 5. Auflage. Hg. v. Wolfgang Schneider. Wiesbaden: Springer Vieweg. Parthier, Rainer (2016): Messtechnik. Grundlagen und Anwendungen der elektrischen Messtechnik. 8. Auflage. Wiesbaden, Springer Fachmedien Wiesbaden. Thrun, Sebastian; Burgard, Wolfram; Fox, Dieter (2006): Probabilistic robotics. Cambridge, Massachusetts, London, England: MIT Press. Wehking, Karl-Heinz (2020): Technisches Handbuch Logistik 1. Fördertechnik, Materialfluss, Intralogistik. Berlin, Heidelberg; Springer Vieweg.

Module M1593: Data Mining

Courses

Title	Typ	Hrs/wk	CP
Data Mining (L2434)	Lecture	2	3
Data Mining (L2435)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Stefan Schulte
Admission Requirements	None
Recommended Previous Knowledge	• Databases • Machine learning
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After successful completion of the course, students know: • Basic concepts for data preparation • Similarity and distance measures • Methods to mine data patterns • Procedures to analyse clusters • Approaches to identify outliers • Data mining for different types of data, e.g., data streams, text data, time series data
Skills	Students are able to analyze large, heterogeneous volumes of data. They know methods and their application to recognize patterns in data sets and data clusters. The students are able to apply the studied methods in different domains, e.g., for data streams, text data, or time series data.
Personal Competence	
Social Competence	Students can work on complex problems both independently and in teams. They can exchange ideas with each other and use their individual strengths to solve the problem.
Autonomy	Students are able to independently investigate a complex problem and assess which competencies are required to solve it.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory: Yes; Bonus: 20 %; Form: Subject theoretical and practical work; Description: Praktische Arbeiten zu bestimmten Themen aus dem Bereich Data Mining
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Data Science: Compulsory Computer Science: Specialisation I. Computer and Software Engineering: Elective Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Data Science: Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L2434: Data Mining

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Schulte, Dr. Dominik Schallmoser
Language	EN
Cycle	WiSe
Content	• Data preparation • Similarity and distance measures • Pattern mining • Cluster analysis • Outliers detection • Data mining for different types of data, e.g., data streams, text data, time series data
Literature	Charu C. Aggarwal: Text Mining - The Textbook, Springer, 2015. Available at https://link.springer.com/book/10.1007/978-3-319-14142-8

Course L2435: Data Mining	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Stefan Schulte, Dr. Dominik Schallmoser
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1890: Strategic Management of Technological Innovation

Courses

Title	Typ	Hrs/wk	CP
Strategic Management of Technological Innovation (L3127)	Lecture	3	3
Strategic Management of Technological Innovation (L3128)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Tim Schweisfurth
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: Yes; Bonus: 20 %; Form: Subject theoretical andsemesterbegleitende practical work; Description: Mini-Tests, Gruppenarbeiten
Examination	Written exam
Examination duration and scale	60 minutes
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L3127: Strategic Management of Technological Innovation

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Tim Schweisfurth
Language	EN
Cycle	WiSe
Content	
Literature	

Course L3128: Strategic Management of Technological Innovation

Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tim Schweisfurth
Language	EN
Cycle	WiSe
Content	
Literature	

Module M1679: Process Management

Courses

Title	Typ	Hrs/wk	CP
Basics of process management (L2810)	Lecture	2	3
Process management practice (L2811)	Seminar	2	3

Module Responsible	Prof. Christian Thies
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory: Yes; Bonus: 20 %; Form: Written elaboration; Description:
Examination	Written exam
Examination duration and scale	60 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L2810: Basics of process management

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Thies
Language	DE
Cycle	WiSe
Content	• Introduction to business process management • Process identification and modeling • Process analysis (qualitative and quantitative methods) • Process improvement, implementation and monitoring
Literature	**Lehrbuch** - Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2021). Grundlagen des Geschäftsprozessmanagements. Übersetzt von T. Grishold, S. Groß, J. Mendling & B. Wurm. Springer Vieweg. **Ergänzende Literatur** - Weske, M. (2019). Business Process Management. Concepts, Languages, Architectures. Springer - Hirzel, M., Geisel, U., & Gaida, I. (2013). Prozessmanagement in der Praxis. Springer Gabler. - Becker, J., Kugeler, M., & Rosemann, M. (2012). Prozessmanagement. Ein Leitfaden zur prozessorientierten Organisationsgestaltung. Springer.

Course L2811: Process management practice

Typ	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Thies
Language	DE
Cycle	WiSe
Content	
Literature	**Lehrbuch** • Seidlmeier, H. (2019). Prozessmodellierung mit ARIS ®. Eine beispielorientierte Einführung für Studium und Praxis in ARIS 10 (5. Auflage). Springer Vieweg. Ergänzende Literatur wird im Seminar bekanntgegeben

Module M0833: Introduction to Control Systems

Courses

Title	Typ	Hrs/wk	CP
Introduction to Control Systems (L0654)	Lecture	2	4
Introduction to Control Systems (L0655)	Recitation Section (small)	2	2

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems • They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus • They can explain the Nyquist stability criterion and the stability margins derived from it. • They can explain the role of the phase margin in analysis and synthesis of control loops • They can explain the way a PID controller affects a control loop in terms of its frequency response • They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	• Students can transform models of linear dynamic systems from time to frequency domain and vice versa • They can simulate and assess the behavior of systems and control loops • They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules • They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques • They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation • They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0654: Introduction to Control Systems	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Signals and systems • Linear systems, differential equations and transfer functions • First and second order systems, poles and zeros, impulse and step response • Stability Feedback systems • Principle of feedback, open-loop versus closed-loop control • Reference tracking and disturbance rejection • Types of feedback, PID control • System type and steady-state error, error constants • Internal model principle Root locus techniques • Root locus plots • Root locus design of PID controllers Frequency response techniques • Bode diagram • Minimum and non-minimum phase systems • Nyquist plot, Nyquist stability criterion, phase and gain margin • Loop shaping, lead lag compensation • Frequency response interpretation of PID control Time delay systems • Root locus and frequency response of time delay systems • Smith predictor Digital control • Sampled-data systems, difference equations • Tustin approximation, digital implementation of PID controllers Software tools • Introduction to Matlab, Simulink, Control toolbox • Computer-based exercises throughout the course
Literature	• Werner, H., Lecture Notes „Introduction to Control Systems“ • G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 • K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 • R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1289: Logistical systems - Industry 4.0

Courses

Title	Typ	Hrs/wk	CP
Logistics systems - Industry 4.0 (L1753)	Seminar	4	6

Module Responsible	Prof. Jochen Kreutzfeldt
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of the module „Technical Logistics“
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to understand and explain the concept "Logistical System". 2. The students are able to design a logistic system conceptually. 3. The students can develop and implement the control of a logistic system with python.
Skills	The students will acquire the following skills: 1. The students are able to identify logistical systems, analyze and identify potential for change and improvement. 2. The students know different technical solutions to address problems in logistical systems. 3. The students are capable of deploying technical solutions and ideas from the concept Industry 4.0 to deal with logistical problems.
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students are able to develop technical solutions for logistical systems and reflect their contribution within the team. 2. The technical solutions from the group can be jointly documented and presented. 3. Students are able to present their technological solutions to an audience and derived from the critique new ideas and improvements.
Autonomy	The students will acquire the following independent competencies: 1. The students can independently develop technical solutions for logistical problems under supervision. 2. The students are able to evaluate their technical solutions and discuss the pros and cons. 3. The students are able to assess the impact of the concept Industry 4.0 on their own career development.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Lab prototype with documentation (group work)
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1753: Logistics systems - Industry 4.0	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Jochen Kreutzfeldt
Language	DE
Cycle	WiSe
Content	The lecture gives an introduction to the concept of logistical systems with a special emphasis on the subject of Industry 4.0. Here, the system concept in logistics from a technical point of view is introduced. A logistical system is understood as a combination of transport, storage and change processes between source and sink of goods. This lecture will look at the technical aspect of these processes. Industry is a topic of this lecture. Industry 4.0 is understood as the far-reaching digitization and networking of logistical systems and the connection of logistical objects, processes and systems. The logistics industry expects Industry 4.0 to be a profound change and the realization of large improvement potentials. The lecture provides an in-depth introduction to application cases and business models of Industry 4.0 in logistics from a technical standpoint. A possible framework for Industry 4.0 is presented and several application examples are shown. In the exercises, students learn will learn the exemplary use of different technical solutions and know how, which can be used to improve logistical systems.
Literature	Bauernhansl, Thomas et al. (2014): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Wiesbaden: Springer Vieweg. Hausladen, Iris (2014): IT-gestützte Logistik. Systeme - Prozesse - Anwendungen. 2. Auflage 2014. Wiesbaden: Imprint: Gabler Verlag. Hompel, Michael ten; Büchter, Hubert; Franzke, Ulrich (2008): Identifikationssysteme und Automatisierung. [Intralogistik]. Berlin, Heidelberg: Springer. Kaufmann, Timothy (2015): Geschäftsmodelle in Industrie 4.0 und dem Internet der Dinge. Der Weg vom Anspruch in die Wirklichkeit. Wiesbaden: Springer Fachmedien Wiesbaden. Martin, Heinrich (2014): Transport- und Lagerlogistik. Planung, Struktur, Steuerung und Kosten von Systemen der Intralogistik. 9., Auflage 2014. Wiesbaden: Imprint: Springer Vieweg. Runkler, Thomas A. (2010): Data-Mining. Methoden und Algorithmen intelligenter Datenanalyse. 1. Aufl. Wiesbaden: Vieweg + Teubner (Studium).

Module M1423: Algorithms and Data Structures

Courses

Title	Typ	Hrs/wk	CP
Algorithms and Data Structures (L2046)	Lecture	4	4
Algorithms and Data Structures (L2047)	Recitation Section (small)	1	2

Module Responsible	Prof. Matthias Mnich
Admission Requirements	None
Recommended Previous Knowledge	• Discrete Algebraic Structures • Mathematics I • Mathematics II • Procedual Programming • Objectoriented Programming
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in algorithm design, algorithm analysis and problem reductions. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model discrete decision, search and optimization problems with the help of the concepts studied in this course. Moreover, they are capable of solving them, and reducing them to each other, by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: No; Bonus: 20 %; Form: Excercises; Description:
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Data Science: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Data Science: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L2046: Algorithms and Data Structures	
Typ	Lecture
Hrs/wk	4
CP	4
Workload in Hours	Independent Study Time 64, Study Time in Lecture 56
Lecturer	Prof. Matthias Mnich
Language	DE/EN
Cycle	WiSe
Content	• Insertion sort • Register machines • Asymptotic analysis, Landau notation • Polynomial-time algorithms and NP-completeness • Divide-and-conquer, merge sort • Strassen algorithm • Greedy algorithm • Dynamic programming • Quick sort • AVL-trees, B-trees • Hashing • Depth first search, breadth first search • Shortest paths • Flow problems, Ford-Fulkerson algorithm
Literature	• T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Introduction to Algorithms. MIT Press, 2013 • S. Skiena: The Algorithm Design Manual. Springer, 2008 • J. M. Kleinberg and É. Tardos. Algorithm Design. Addison-Wesley, 2005.

Course L2047: Algorithms and Data Structures	
Typ	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Mnich
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1592: Statistics

Courses

Title	Typ	Hrs/wk	CP
Statistics (L2430)	Lecture	3	4
Statistics (L2431)	Recitation Section (small)	1	2

Module Responsible	Prof. Matthias Schulte
Admission Requirements	None
Recommended Previous Knowledge	Stochastics (or a comparable class)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in Statistics. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples.
Skills	• Students can model statistical problems with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. They are able to use the statistical software R. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together (e.g. on their regular home work) in heterogeneously composed teams and to present their results appropriately (e.g. during exercise class). • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students can put their knowledge in relation to the contents of other lectures. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Data Science: Compulsory Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory Engineering Science: Specialisation Data Science: Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L2430: Statistics	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Matthias Schulte
Language	DE/EN
Cycle	WiSe
Content	• Multivariate distributions and stochastic convergence • Point estimators • Confidence intervals • Hypothesis testing • Nonparametric statistics • Linear Regression • Time series analysis • Statistical software (R)
Literature	• L. Dümbgen (2016): Einführung in die Statistik, Birkhäuser. • L. Dümbgen (2003): Stochastik für Informatiker, Springer. • H.-O. Georgii (2012): Stochastics: Introduction to Probability and Statistics, 2nd edition, De Gruyter. • N. Henze (2018): Stochastik für Einsteiger, 12th edition, Springer. • A. Klenke (2014): Probability Theory: A Comprehensive Course, 2nd edition, Springer. • U. Krengel (2005): Einführung in die Wahrscheinlichkeitstheorie und Statistik, 8th edition, Vieweg.

Course L2431: Statistics	
Typ	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Matthias Schulte
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0853: Mathematics III

Courses

Title	Typ	Hrs/wk	CP
Analysis III (L1028)	Lecture	2	2
Analysis III (L1029)	Recitation Section (small)	1	1
Analysis III (L1030)	Recitation Section (large)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Differential Equations) (L1032)	Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1033)	Recitation Section (large)	1	1

Module Responsible	Prof. Marko Lindner
Admission Requirements	None
Recommended Previous Knowledge	Mathematics I + II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112
Credit points	8
Course achievement	None
Examination	Written exam
Examination duration and scale	60 min (Analysis III) + 60 min (Differential Equations 1)
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory

Course L1028: Analysis III	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of differential and integrational calculus of several variables • Differential calculus for several variables • Mean value theorems and Taylor's theorem • Maximum and minimum values • Implicit functions • Minimization under equality constraints • Newton's method for multiple variables • Fourier series • Double integrals over general regions • Line and surface integrals • Theorems of Gauß and Stokes
Literature	• http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1029: Analysis III	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1030: Analysis III	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1031: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of the theory and numerical treatment of ordinary differential equations • Introduction and elementary methods • Exsitence and uniqueness of initial value problems • Linear differential equations • Stability and qualitative behaviour of the solution • Boundary value problems and basic concepts of calculus of variations • Eigenvalue problems • Numerical methods for the integration of initial and boundary value problems • Classification of partial differential equations
Literature	• http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1032: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1033: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1070: Simulation of Transport and Handling Systems

Courses

Title	Typ	Hrs/wk	CP
Simulation of Transport and Handling Systems (L1352)	Lecture	1	2
Simulation of Transport and Handling Systems (L1818)	Recitation Section (small)	3	4

Module Responsible	Prof. Carlos Jahn
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of transport- and handlingtechnology.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can... • Explain the structure and workings of standard external logistics systems. • Outline the benefits of using simulation software subject to the starting situation. • Present different simulation programs and kinds of simulation that are in widespread use and explain their characteristics.
Skills	Students are able to... • Recognize, analyze, and assemble into a model the elementary building blocks of a logistics system. • Map complex external logistics process using the *Plant Simulation*® simulation software. • Draw inferences from the results of the simulation, transfer them to the reality, and deduce action recommendations from them.
Personal Competence	
Social Competence	Students are capable of... • Solving complex tasks in a team and to document assignments accordingly. • Playing different roles in the teamwork and giving each other appropriate feedback in the team. • Presenting the relevant results of their project to specialists and representing them.
Autonomy	Students are able... • To acquaint themselves independently with software with which they are not familiar and to use it to solve complex tasks. • To define work steps independently and to acquire the knowledge required to do so.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Subject theoretical and practical work
Examination	Subject theoretical and practical work
Examination duration and scale	Simulation study and report with approximately 15 pages per person
Assignment for the Following Curricula	Data Science: Core Qualification: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1352: Simulation of Transport and Handling Systems	
Typ	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	The lecture deals with the simulation of external logistics systems. The focus is therefore on the consideration of logistical processes between companies or on transhipment systems, such as ports or individual terminals. In the first part of the lecture, students will first acquire basic knowledge of external logistics systems and the advantages of using simulations to present them. Then an overview of existing simulation types and programs is given and examples for existing simulation models of logistic systems in science and practice are shown. Some simulation models will be demonstrated. In the second part of the lecture the students learn the basic handling of the simulation software Plant Simulation®. They receive theoretical explanations of the general functionality of the simulation tool, which are further deepened through the use of extensive, interactive examples. At the same time, five exercises, which build on each other, offer students the opportunity to implement the course content they have learnt alone and in small groups. The exercises can be completed during the supervised lecture periods as well as at other times. The acquired knowledge is to be applied in the third part in the course of group work. The students will be divided into groups, each of which will then work on a relevant problem from the field of (external) logistic systems by means of simulation. The students are given a defined period of time for their work. During this time at least one person is always available for questions and suggestions. The results of the group work are to be documented in a simulation report and handed in at the end of the processing time. Finally, the individual groups present the problems they have worked on and their results in a presentation.
Literature	Bangsow, Steffen (2011): Praxishandbuch Plant Simulation und SimTalk. Anwendung und Programmierung in über 150 Beispiel-Modellen. München: Hanser Verlag. Eley, Michael (2012): Simulation in der Logistik. Einführung in die Erstellung ereignisdiskreter Modelle unter Verwendung des Werkzeuges "Plant Simulation". Berlin, Heidelberg: Springer. Engelhardt-Nowitzki, Corinna; Nowitzki, Olaf; Krenn, Barbara (2008): Management komplexer Materialflüsse mittels Simulation. State-of-the-Art und innovative Konzepte. Wiesbaden: Deutscher Universitäts-Verlag / GWV Fachverlage GmbH, Wiesbaden. Rabe, Markus; Spieckermann, Sven; Wenzel, Sigrid (2008): Verifikation und Validierung für die Simulation in Produktion und Logistik. Vorgehensmodelle und Techniken. Berlin, Heidelberg: Springer. Sargent, Robert G. (2010): Verification and Validation of Simulation Models. In: B. Johansson, S. Jain, J. Montoya-Torres, J. Hugan, and E. Yücesan, eds.: Proceedings of the 2010 Winter Simulation Conference. VDI-Richlinie: VDI 3633. Simulation von Logistik-, Materialfluß-und Produktionssystemen Wenzel, Sigrid; Rabe, Markus; Spieckermann, Sven (2006): Verifikation und Validierung für die Simulation in Produktion und Logistik. Vorgehensmodelle und Techniken. 1. Aufl. Berlin: Springer Berlin.

Course L1818: Simulation of Transport and Handling Systems	
Typ	Recitation Section (small)
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1349: Object-oriented programming in logistics

Courses

Title	Typ	Hrs/wk	CP
Object-oriented programming in logistics (L1901)	Seminar	4	6

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Basic computer skills Computer Science for Engineers - Introduction and Overview
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to explain the basics of object-oriented programming with Java. 2. The students know basic data types, control structures and basic concepts of object orientation and inheritance in the Java programming language. 3. The students know the necessary tools for programming with Java.
Skills	The students will acquire the following skills: 1. The students will be able to develop and run programs with Java independently. 2. The students will be able to develop and implement own objects and classes with Java. 3. The students are able to identify and overcome failures autonomously (debugging).
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students can explain self-developed programs to other students. 2. The students can support others in finding failures and mistakes in their software-code. 3. The students are able to present their programs in front of a audience.
Autonomy	The students will acquire the following competencies: 1. The students work independently with an initially unknown programming language (Java). 2. The students are able to derive independently the necessary source code for a given problem. 3. The students are able to write their own source code in Java based on given a problem.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1901: Object-oriented programming in logistics	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	NN
Language	DE
Cycle	WiSe
Content	The seminar provides an introduction to object-oriented programming with Java. Practical knowledge will be transferred through programming exercises parallel to theoretical content. The exercises will deal mainly with logistical problems. The seminar will be conducted as an integrated seminar with a combination of theoretical content and autonomously solved programming problems on the computer. Furthermore, the student will become familiar with the standard libraries of Java and their properties and functions. These standard objects will be used, if necessary with the assistance of an instructor, to build own programs. Furthermore, an introduction to the actual software development kits (SDK) of Java will be given.
Literature	Goll, Joachim; Heinisch, Cornelia (2014): Java als erste Programmiersprache. Ein professioneller Einstieg in die Objektorientierung mit Java. 7. Aufl. 2014. Wiesbaden: Imprint: Springer Vieweg. Jobst, Fritz (2015): Programmieren in Java. [aktuell zu Java 8]. 7., vollst. überarb. Aufl. München: Hanser. Abts, Dietmar (2015): Grundkurs JAVA. Von den Grundlagen bis zu Datenbank- und Netzanwendungen. 8. Aufl. Wiesbaden: Springer Vieweg.

Module M0980: Logistics, Transport and Environment

Courses

Title	Typ	Hrs/wk	CP
Logistics, Transport and Environment (L0009)	Project-/problem-based Learning	2	4
Environmental Management and Corporate Responsibilty (L1160)	Seminar	2	2

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	• Introduction to logistics and mobility • Foundations of Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • explain basic terms of transport logistics, commercial traffic, transport policy and sustainability • describe actors and system boundaries, challenges and goals of transport logistics • reflect standards of sustainability management
Skills	Students are able to... • design logistics systems independently • differentiate sustainability, CR, CSR and environmental management • critically evaluate measures for sustainable logistics and develop them
Personal Competence	
Social Competence	Students can... • creatively develop solutions in teams and work out presentations • present their knowledge and skills to other students
Autonomy	Students can... • carry out small research studies independently • apply theoretical knowledge in practical projects • apply presentation techniques such as free speech, designing charts (i.e. in Power-Point), use of media (Flip-Charts, Whiteboard, Metaplan)
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Written assignment with short presentation
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L0009: Logistics, Transport and Environment	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	Application and creative development of professional knowledge within the framework of the case study "Environmental impacts of supply chains" using a specific company as example. Depending on the chosen focus of the academic year: • characteristics of different transport systems • technologies, structures and processes of transport logistics systems (nodes, network, interactions) • location and route planning • connections of information flow and material flows in transport chains • interrelation between private and private (contract logistics) and private and public (business policy, transport policy) and their (diverging) • design approaches for sustainable logistics
Literature	Ihde, Gösta B.: Transport, Verkehr, Logistik. Gesamtwirtschaftliche Aspekte und einzelwirtschaftliche Handhabung. 3. überarbeitete Auflage. Vahlen, München 2001

Course L1160: Environmental Management and Corporate Responsibilty	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	• Imparting knowledge about standards (e.g. EMAS and ISO 14.001) as important methodological approaches for the integration of environmental and sustainability management in business companies • Explaination of theoretical concepts of corporate sustainability management • Imparting pracitical knowledge from different stakeholder views: consulting company, trading enterprise, NGO, financial market
Literature	--

Module M1595: Machine Learning I

Courses

Title	Typ	Hrs/wk	CP
Machine Learning I (L2432)	Lecture	2	3
Machine Learning I (L2433)	Recitation Section (small)	3	3

Module Responsible	Prof. Nihat Ay
Admission Requirements	None
Recommended Previous Knowledge	Linear Algebra, Analysis, Basic Programming Course
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students know • general principles of machine learning learning: supervised/unsupervised learning, generative/descriptive learning, parametric/non-parametric learning • different learning methods: neural networks, support vector machines, clustering, dimensionality reduction, kernel methods • fundamentals of statistical learning theory • advanced techniques such as transfer learning, reinforcement learning, generative adversarial networks and adaptive control
Skills	The students can • apply machine learning methods to concrete problems • select and evaluate suitable methods for specific problems • evaluate the quality of a trained data-driven model • work with known software frameworks for machine learning • adapt the architecture and cost function of neural networks to specific problems • show the limits of machine learning methods
Personal Competence	
Social Competence	Students can work on complex problems both independently and in teams. They can exchange ideas with each other and use their individual strengths to solve the problem.
Autonomy	Students are able to independently investigate a complex problem and assess which competencies are required to solve it.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Excercises
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Data Science: Compulsory Computer Science: Specialisation I. Computer and Software Engineering: Elective Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory Engineering Science: Specialisation Mechatronics: Elective Compulsory Engineering Science: Specialisation Data Science: Compulsory Engineering Science: Specialisation Mechanical Engineering: Elective Compulsory Computer Science in Engineering: Specialisation I. Computer Science: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L2432: Machine Learning I	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Nihat Ay
Language	DE/EN
Cycle	SoSe
Content	• History of neuroscience and machine learning (in particular, the age of deep learning) • McCulloch-Pitts neurons and binary Artificial Neural Networks • Boolean and threshold functions • Universality of McCulloch-Pitts neural networks • Learning and the perceptron convergence theorem • Support vector machines • Harmonic analysis of Boolean functions • Continuous Artificial Neural Networks • Kolmogorov's superposition theorem • Universal approximation with continuous neural networks • Approximation error and the gradient decent method: the general idea • The stochastic gradient decent method (Robbins-Monro and Kiefer-Wolfowitz cases) • Multilayer networks and the backpropagation algorithm • Statistical Learning Theory
Literature	• Martin Anthony and Peter L. Bartlett. Neural Network Learning: Theoretical Foundations. Cambridge University Press, 1999. • Martin Anthony. Discrete Mathematics of Neural Networks: Selected Topics. SIAM Monographs on Discrete Mathematics & Applications, 1987. • Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar. Foundations of Machine Learning, Second Edition. MIT Press, 2018. • Christopher M. Bishop. Pattern Recognition and Machine Learning. Information Science and Statistics. Springer-Verlag, 2008. • Bernhard Schölkopf, Alexander Smola. Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond. Adaptive Computation and Machine Learning series. MIT Press, Cambridge, MA, 2002. • Luc Devroye, László Györfi, Gábor Lugosi. A Probabilistic Theory of Pattern Recognition. Springer, 1996. • Vladimir Vapnik. The Nature of Statistical Learning Theory. Springer-Verlag: New York, Berlin, Heidelberg, 1995.

Course L2433: Machine Learning I	
Typ	Recitation Section (small)
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nihat Ay
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0727: Stochastics

Courses

Title	Typ	Hrs/wk	CP
Stochastics (L0777)	Lecture	2	4
Stochastics (L0778)	Recitation Section (small)	2	2

Module Responsible	Prof. Matthias Schulte
Admission Requirements	None
Recommended Previous Knowledge	• Calculus • Discrete algebraic structures (combinatorics) • Propositional logic
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in Stochastics. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems from stochastics with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together (e.g. on their regular home work) in heterogeneously composed teams (i.e., teams from different study programs and background knowledge) and to present their results appropriately (e.g. during exercise class). • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students can put their knowledge in relation to the contents of other lectures. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Data Science: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory Engineering Science: Specialisation Data Science: Compulsory Engineering Science: Specialisation Electrical Engineering: Elective Compulsory Engineering Science: Specialisation Electrical Engineering: Elective Compulsory Computer Science in Engineering: Core Qualification: Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Orientation Studies: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Core Qualification: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L0777: Stochastics	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Matthias Schulte
Language	DE/EN
Cycle	SoSe
Content	• Definitions of probability, conditional probability • Random variables • Independence • Distributions and density functions • Characteristics: expectation, variance, standard deviation, moments • Multivariate distributions • Law of large numbers and central limit theorem • Basic notions of stochastic processes • Basic concepts of statistics (point estimators, confidence intervals, hypothesis testing)
Literature	• L. Dümbgen (2003): Stochastik für Informatiker, Springer. • H.-O. Georgii (2012): Stochastics: Introduction to Probability and Statistics, 2nd edition, De Gruyter. • N. Henze (2018): Stochastik für Einsteiger, 12th edition, Springer. • A. Klenke (2014): Probability Theory: A Comprehensive Course, 2nd edition, Springer. • U. Krengel (2005): Einführung in die Wahrscheinlichkeitstheorie und Statistik, 8th edition, Vieweg. • A.N. Shiryaev (2012): Problems in probability, Springer.

Course L0778: Stochastics	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Matthias Schulte
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Specialization Production Management and Processes

Module M0865: Fundamentals of Production and Quality Management

Courses

Title	Typ	Hrs/wk	CP
Production Process Organization (L0925)	Lecture	2	3
Quality Management (L0926)	Lecture	2	3

Module Responsible	Prof. Hermann Lödding
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to explain the contents of the lecture of the module.
Skills	Students are able to apply the methods and models in the module to industrial problems.
Personal Competence	
Social Competence	-
Autonomy	-
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 Minuten
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Elective Compulsory Engineering Science: Specialisation Mechatronics: Elective Compulsory Engineering Science: Specialisation Mechanical Engineering: Elective Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Mechanical Engineering: Core Qualification: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory

Course L0925: Production Process Organization

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe
Content	(A) Introduction (B) Product planning (C) Process planning (D) Procurement (E) Manufacturing (F) Production planning and control (PPC) (G) Distribution (H) Cooperation
Literature	Wiendahl, H.-P.: Betriebsorganisation für Ingenieure Vorlesungsskript

Course L0926: Quality Management	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Hermann Lödding
Language	EN
Cycle	SoSe
Content	• Definition and Relevance of Quality • Continuous Quality Improvement • Quality Management in Product Development • Quality Management in Production Processes • Design of Experiments
Literature	• Pfeifer, Tilo: Quality Management. Strategies, Methods, Techniques; Hanser-Verlag, München 2002 • Pfeifer, Tilo: Qualitätsmanagement. Strategien, Methoden, Techniken; Hanser-Verlag, München, 3. Aufl. 2001 • Mitra, Amitava: Fundamentals of Quality Control and Improvement; Wiley; Macmillan, 2008 • Kleppmann, W.: Taschenbuch Versuchsplanung. Produkte und Prozesse optimieren; Hanser-Verlag, München, 6. Aufl. 2009

Module M1897: New Technologies and Markets

Courses

Title	Typ	Hrs/wk	CP
Data-driven marketing and sales (L3138)	Lecture	3	4
New technologies and market opportunities (L3139)	Project-/problem-based Learning	1	2

Module Responsible	Prof. Christian Lüthje
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Written elaboration, exercises, presentation, oral participation
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L3138: Data-driven marketing and sales

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	
Literature	

Course L3139: New technologies and market opportunities

Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	
Literature	

Module M0594: Fundamentals of Mechanical Engineering Design

Courses

Title	Typ	Hrs/wk	CP
Fundamentals of Mechanical Engineering Design (L0258)	Lecture	2	3
Fundamentals of Mechanical Engineering Design (L0259)	Recitation Section (large)	2	3

Module Responsible	Prof. Dieter Krause
Admission Requirements	None
Recommended Previous Knowledge	• Basic knowledge about mechanics and production engineering • Internship (Stage I Practical)
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After passing the module, students are able to: • explain basic working principles and functions of machine elements, • explain requirements, selection criteria, application scenarios and practical examples of basic machine elements, indicate the background of dimensioning calculations.
Skills	After passing the module, students are able to: • accomplish dimensioning calculations of covered machine elements, • transfer knowledge learned in the module to new requirements and tasks (problem solving skills), • recognize the content of technical drawings and schematic sketches, • technically evaluate basic designs.
Personal Competence	
Social Competence	• Students are able to discuss technical information in the lecture supported by activating methods.
Autonomy	• Students are able to independently deepen their acquired knowledge in exercises. • Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0258: Fundamentals of Mechanical Engineering Design	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Dr. Nikola Bursac, Prof. Sören Ehlers
Language	DE
Cycle	SoSe

Content	**Lecture**
	• Introduction to design
	• Introduction to the following machine elements
	  ◦ Screws
	  ◦ Shaft-hub joints
	  ◦ Rolling contact bearings
	  ◦ Welding / adhesive / solder joints
	  ◦ Springs
	  ◦ Axes & shafts
	• Presentation of technical objects (technical drawing)
	Exercise
	• Calculation methods for dimensioning the following machine elements:
	  ◦ Screws
	  ◦ Shaft-hub joints
	  ◦ Rolling contact bearings
	  ◦ Welding / adhesive / solder joints
	  ◦ Springs
	  ◦ Axis & shafts

Literature	• Dubbel, Taschenbuch für den Maschinenbau; Grote, K.-H., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. • Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. • Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. • Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. • Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. • Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. • Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. • Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. • Sowie weitere Bücher zu speziellen Themen

Course L0259: Fundamentals of Mechanical Engineering Design	
Typ	Recitation Section (large)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Dieter Krause, Prof. Dr. Nikola Bursac, Prof. Sören Ehlers
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0725: Production Engineering

Courses

Title	Typ	Hrs/wk	CP
Production Engineering I (L0608)	Lecture	2	2
Production Engineering I (L0612)	Recitation Section (large)	1	1
Production Engineering II (L0610)	Lecture	2	2
Production Engineering II (L0611)	Recitation Section (large)	1	1

Module Responsible	Prof. Jan Hendrik Dege
Admission Requirements	None
Recommended Previous Knowledge	no course assessments required internship recommended
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to ... • name basic criteria for the selection of manufacturing processes. • name the main groups of Manufacturing Technology. • name the application areas of different manufacturing processes. • name boundaries, advantages and disadvantages of the different manufacturing process. • describe elements, geometric properties and kinematic variables and requirements for tools, workpiece and process. • explain the essential models of manufacturing technology.
Skills	Students are able to... • select manufacturing processes in accordance with the requirements. • design manufacturing processes for simple tasks to meet the required tolerances of the component to be produced. • assess components in terms of their production-oriented construction.
Personal Competence	
Social Competence	Students are able to ... • develop solutions in a production environment with qualified personnel at technical level and represent decisions.
Autonomy	Students are able to .. • interpret independently the manufacturing process. • assess own strengths and weaknesses in general. • assess their learning progress and define gaps to be improved. • assess possible consequences of their actions.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Medical Engineering: Elective Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory

Course L0608: Production Engineering I	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jan Hendrik Dege
Language	DE
Cycle	SoSe
Content	• Manufacturing Accuracy • Manufacturing Metrology • Measurement Errors and Uncertainties • Introduction to Forming • Massiv forming and Sheet Metal Forming • Introduction to Machining Technology • Geometrically defined machining (Turning, milling, drilling, broaching, planning)
Literature	Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter,; Ziegmann, Gerhard,;) Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007 Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004 Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008 Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008 Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008) Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006 Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996 Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004)

Course L0612: Production Engineering I	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jan Hendrik Dege
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0610: Production Engineering II	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jan Hendrik Dege, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	• Geometrically undefined machining (grinding, lapping, honing) • Introduction into erosion technology • Introduction into blastig processes • Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) • Fundamentals of Laser Technology • Process versions and Fundamentals of Laser Joining Technology
Literature	Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.] : Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie : Technologien und Werkstoffe. Berlin [u.a.] : Springer, 2007

Course L0611: Production Engineering II	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jan Hendrik Dege, Prof. Claus Emmelmann
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1680: Automation in logistics

Courses

Title	Typ	Hrs/wk	CP
Automation in logistics - Lab (L2913)	Project-/problem-based Learning	2	2
Automation in logistics - seminar (L2688)	Seminar	2	4

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	"Technical logistics" successfully completed "Computer Science for Engineers - Introduction and Overview" successfully completed
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	1. The students know the basic principles of measurement and control technology. 2. The students know localization and navigation solutions used in mobile robotics. 3. The students know automation solutions for storage and order picking. 4. The students can developed and implement basic programs with a programmable logic controller.
Skills	1. The students can describe and evaluate basic control loops. 2. The students can carry out algorithms for localization and navigation. 3. The Students can evaluate the performance of automated storage and picking solutions.
Personal Competence	
Social Competence	1. The students are able to explain the basic principles of measurement and control technology to other students. 2. The students can help other students to find algorithmic errors in localization and navigation algorithms. 3. The students are able to present their results in front of an audience.
Autonomy	1. The students familiarize themselves independently with unknown algorithms. 2. The students are able to independently find a suitable automation approach for a problem. 3. Based on the given task, the students can design an appropriate automation solution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6

Course achievement	Compulsory	Bonus	Form	Description
	Yes	10 %	Attestation	Programmieraufgaben in SPS

Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L2913: Automation in logistics - Lab

Typ	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Introduction to programmable logic controllers (PLC) with CodeSys PLC basics with function blocks and structured text Integration of sensors and actuators Testing of PLC programs in a simulation Transfer of own PLC programs to real control hardware
Literature	Wellenreuther, Günter; Zastrow, Dieter (2016): Automatisieren mit SPS - Übersichten und Übungsaufgaben. Von Grundverknüpfungen bis Ablaufsteuerungen, Wortverarbeitungen und Regelungen, Programmieren mit STEP 7 und CoDeSys, Beispiele, Lernaufgaben, Kontrollaufgaben, Lösungen. 7. Auflage. Wiesbaden: Springer Vieweg (Lehrbuch).

Course L2688: Automation in logistics - seminar	
Typ	Seminar
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	(1) Measurement and sensor technology (2) Basics of control theory (3) Autonomous Mobile Robots (4) Automated storage systems (5) Robotics in order picking.
Literature	Heinrich, Berthold (2019): Grundlagen Regelungstechnik. 5. Auflage. Hg. v. Wolfgang Schneider. Wiesbaden: Springer Vieweg. Parthier, Rainer (2016): Messtechnik. Grundlagen und Anwendungen der elektrischen Messtechnik. 8. Auflage. Wiesbaden, Springer Fachmedien Wiesbaden. Thrun, Sebastian; Burgard, Wolfram; Fox, Dieter (2006): Probabilistic robotics. Cambridge, Massachusetts, London, England: MIT Press. Wehking, Karl-Heinz (2020): Technisches Handbuch Logistik 1. Fördertechnik, Materialfluss, Intralogistik. Berlin, Heidelberg; Springer Vieweg.

Module M0608: Basics of Electrical Engineering

Courses

Title	Typ	Hrs/wk	CP
Basics of Electrical Engineering (L0290)	Lecture	3	4
Basics of Electrical Engineering (L0292)	Recitation Section (small)	2	2

Module Responsible	Prof. Thorsten Kern
Admission Requirements	None
Recommended Previous Knowledge	Basics of mathematics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can to draw and explain circuit diagrams for electric and electronic circuits with a small number of components. They can describe the basic function of electric and electronic componentes and can present the corresponding equations. They can demonstrate the use of the standard methods for calculations.
Skills	Students are able to analyse electric and electronic circuits with few components and to calculate selected quantities in the circuits. They apply the ususal methods of the electrical engineering for this.
Personal Competence	
Social Competence	Students are enabled to collaborate in interdisciplinary teams with electrical engineering as a common language With this, they are learning communication in a target-oriented communication style, are able to understand interfaces to neighboring engineering disciplines and learn about commonalities but also limits in the different directions of engineering.
Autonomy	Students are able independently to analyse electric and electronic circuits and to calculate selected quantities in the circuits.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Subject theoretical and practical work / Während des Semesters werden Hausarbeiten in Form von elektrischen Aufgaben vergeben, für die durch Simulation eine Lösung entwickelt und nachgewiesen werden muss.
Examination	Subject theoretical and practical work
Examination duration and scale	135 minutes
Assignment for the Following Curricula	Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0290: Basics of Electrical Engineering

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe
Content	DC networks: Current, voltage, power, Kirchhoff's laws, equivalent sources, network analysis AC: Characteristics, RMS, complexe representation, phasor diagrams, power Three phase AC: Characterisitics, star-delta- connection, power, transformer Elektronics: Principle, operating behaviour and application of electronic devises as diode, Zener-diode, thyristor, transistor operational amplifier
Literature	Alexander von Weiss, Manfred Krause: "Allgemeine Elektrotechnik"; Viweg-Verlag, Signatur der Bibliothek der TUHH: ETB 309 Ralf Kories, Heinz Schmitt - Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - andere Autoren

Course L0292: Basics of Electrical Engineering	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Weitere Mitarbeiter
Language	DE
Cycle	WiSe
Content	Excercises to the analysis of circuits and the calculation of electrical quantities th the topics: DC networks: Current, voltage, power, Kirchhoff's laws, equivalent sources, network analysis AC: Characteristics, RMS, complexe representation, phasor diagrams, power Three phase AC: Characterisitics, star-delta- connection, power, transformer Elektronics: Principle, operating behaviour and application of electronic devises as diode, Zener-diode, thyristor, transistor operational amplifier
Literature	Alexander von Weiss, Manfred Krause: "Allgemeine Elektrotechnik"; Viweg-Verlag, Signatur der Bibliothek der TUHH: ETB 309 Ralf Kories, Heinz Schmitt - Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - andere Autoren

Module M1890: Strategic Management of Technological Innovation

Courses

Title	Typ	Hrs/wk	CP
Strategic Management of Technological Innovation (L3127)	Lecture	3	3
Strategic Management of Technological Innovation (L3128)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Tim Schweisfurth
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: Yes; Bonus: 20 %; Form: Subject theoretical andsemesterbegleitende practical work; Description: Mini-Tests, Gruppenarbeiten
Examination	Written exam
Examination duration and scale	60 minutes
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L3127: Strategic Management of Technological Innovation

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Tim Schweisfurth
Language	EN
Cycle	WiSe
Content	
Literature	

Course L3128: Strategic Management of Technological Innovation

Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tim Schweisfurth
Language	EN
Cycle	WiSe
Content	
Literature	

Module M1679: Process Management

Courses

Title	Typ	Hrs/wk	CP
Basics of process management (L2810)	Lecture	2	3
Process management practice (L2811)	Seminar	2	3

Module Responsible	Prof. Christian Thies
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory: Yes; Bonus: 20 %; Form: Written elaboration; Description:
Examination	Written exam
Examination duration and scale	60 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L2810: Basics of process management

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Thies
Language	DE
Cycle	WiSe
Content	• Introduction to business process management • Process identification and modeling • Process analysis (qualitative and quantitative methods) • Process improvement, implementation and monitoring
Literature	**Lehrbuch** - Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2021). Grundlagen des Geschäftsprozessmanagements. Übersetzt von T. Grishold, S. Groß, J. Mendling & B. Wurm. Springer Vieweg. **Ergänzende Literatur** - Weske, M. (2019). Business Process Management. Concepts, Languages, Architectures. Springer - Hirzel, M., Geisel, U., & Gaida, I. (2013). Prozessmanagement in der Praxis. Springer Gabler. - Becker, J., Kugeler, M., & Rosemann, M. (2012). Prozessmanagement. Ein Leitfaden zur prozessorientierten Organisationsgestaltung. Springer.

Course L2811: Process management practice

Typ	Seminar
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Christian Thies
Language	DE
Cycle	WiSe
Content	
Literature	**Lehrbuch** • Seidlmeier, H. (2019). Prozessmodellierung mit ARIS ®. Eine beispielorientierte Einführung für Studium und Praxis in ARIS 10 (5. Auflage). Springer Vieweg. Ergänzende Literatur wird im Seminar bekanntgegeben

Module M0933: Fundamentals of Materials Science

Courses

Title	Typ	Hrs/wk	CP
Fundamentals of Materials Science I (L1085)	Lecture	2	2
Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506)	Lecture	2	2
Physical and Chemical Basics of Materials Science (L1095)	Lecture	2	2

Module Responsible	Prof. Jörg Weißmüller
Admission Requirements	None
Recommended Previous Knowledge	Highschool-level physics, chemistry und mathematics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature.
Skills	The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior.
Personal Competence	
Social Competence	-
Autonomy	-
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	180 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Compulsory Data Science: Specialisation II. Application: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1085: Fundamentals of Materials Science I

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jörg Weißmüller
Language	DE
Cycle	WiSe
Content	
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 P. Haasen: Physikalische Metallkunde. Springer 1994

Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Gerold Schneider
Language	DE
Cycle	WiSe
Content	Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe
Literature	Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7

Course L1095: Physical and Chemical Basics of Materials Science	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Gregor Vonbun-Feldbauer
Language	DE
Cycle	WiSe
Content	• Motivation: „Atoms in Mechanical Engineering?“ • Basics: Force and Energy • The electromagnetic Interaction • „Detour“: Mathematics (complex e-funktion etc.) • The atom: Bohr's model of the atom • Chemical bounds • The multi part problem: Solutions and strategies • Descriptions of using statistical thermodynamics • Elastic theory of atoms • Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems)
Literature	Für den **Elektromagnetismus:** • Bergmann-Schäfer: „Lehrbuch der Experimentalphysik“, Band 2: „Elektromagnetismus“, de Gruyter Für die **Atomphysik:** • Haken, Wolf: „Atom- und Quantenphysik“, Springer Für die **Materialphysik und Elastizität:** • Hornbogen, Warlimont: „Metallkunde“, Springer

Module M0956: Measurement Technology for Mechanical Engineers

Courses

Title	Typ	Hrs/wk	CP
Practical Course: Measurement and Control Systems (L1119)	Practical Course	2	2
Measurement Technology for Mechanical Engineering (L1116)	Lecture	2	2
Measurement Technology for Mechanical Engineering (L1118)	Practical Course	2	2

Module Responsible	Prof. Thorsten Kern
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of physics, chemistry and electrical engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to name the most important fundmentals of the Measurement Technology (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Sensors and Systems). They can outline the most important measuring methods for different kinds of quantities to be maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency). They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Gas Chromatography)
Skills	Students can select suitable measuring methods to given problems and can use refering measurement devices in practice. The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area.
Personal Competence	
Social Competence	Students can arrive at work results in groups and document them in a common report.
Autonomy	Students are able to familiarize themselves with new measurement technologies.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / None / Subject theoretical and practical work
Examination	Subject theoretical and practical work
Examination duration and scale	Successfull execution of up to 12 short experiments on measurements technology and sucessfull participation in the practical course of "Practical Course: Measurement and Control Systems"
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Advanced Materials: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechatronics: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Specialisation Electrical Systems: Compulsory Mechatronics: Specialisation Dynamic Systems and AI: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Medical Engineering: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1119: Practical Course: Measurement and Control Systems	
Typ	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe/SoSe
Content	**The content of experiment 1:** Accuracy testing of a delta robot: In the course of the experiment, the accuracy of a delta robot is tested through 3 tasks. The first task focuses on the online/offline programming of the robot. The second task deals with sensor calibration. In the third task, the radius of a sphere is determined using three different measurement methods (manual measurement, manual measurement with a sensor, automatic data acquisition and data processing). **The content of experiment 3:** The aim of the task is to enable the parallel kinematics to find objects, grasp them and place them on a static target position For this purpose, the end effector of the kinematics is equipped with an optical sensor (camera), whose characteristics are to be defined. The measuring range of the sensor is to be identified and, based on this, a movement strategy for finding the objects is to be developed and implemented. Once the objects have been found, they are to be picked up with a magnetic gripper and transported to their destination. **The content of experiment 4:** The aim of the task is to enable the parallel kinematics to find objects, grab them and deposit them on a moving platform. For this purpose, the end effector of the kinematics is equipped with an optical sensor (camera), the properties of which were worked out in experiment 3. Based on this, the parallel kinematics should now be able to follow the moving platform. For this purpose, a position control must be developed and implemented. Once the controller has been appropriately configured, the objects can be placed on the moving platform.
Literature	Versuch 1: • 1)Weck, Manfred; Brecher, Christian. Maschinenarten und Anwendungsbereiche. Springer (Werkzeugmaschinen, 1, Ed. 6). 2005 • 2)Weck, Manfred; Brecher, Christian. Automatisierung von Maschinen und Anlagen. Springer (Werkzeugmaschinen, 4, Ed. 6). 2006 • 3)Siciliano, Bruno; Khatib, Oussama. Springer handbook of robotics. Springer. 2008 • 4)Schüppstuhl, Thorsten. VL Grundlagen der Handhabungs- und Montagetechnik. 2017 Versuch 3: • 1)Hompel, Michael, Hubert Büchter, and Ulrich Franzke. Identifikationssysteme und Automatisierung. Springer-Verlag, 2007. • ArUco Library Documentation, https://docs.google.com/document/d/1QU9KoBtjSM2kF6lTOjQ76xqL7H0TEtXriJX5kwi9Kgc/edit Stand 10/21 • Demant, Christian, Bernd Streicher-Abel, and Axel Springhoff. Industrielle Bildverarbeitung: wie optische Qualitätskontrolle wirklich funktioniert. Springer-Verlag, 2011. Versuch 4: • 1)Will, Thorsten T. C++ Das umfassende Handbuch, Rheinwerk Computing, 2020 • 2)Hildebrand, Walter. Grundkurs Regelungstechnik : Grundlagen für Bachelorstudiengänge aller technischen Fachrichtungen und Wirtschaftsingenieure, Springer Vieweg, 2013. • 3)Erlenkötter, Helmut. C++: Objektorientiertes Programmieren von Anfang an, rororo, 2016 Bibliography: Experiment 1 • 1)Weck, Manfred; Brecher, Christian. Maschinenarten und Anwendungsbereiche. Springer (Werkzeugmaschinen, 1, Ed. 6). 2005 • 2)Weck, Manfred; Brecher, Christian. Automatisierung von Maschinen und Anlagen. Springer (Werkzeugmaschinen, 4, Ed. 6). 2006 • 3)Siciliano, Bruno; Khatib, Oussama. Springer handbook of robotics. Springer. 2008 • 4)Schüppstuhl, Thorsten. VL Grundlagen der Handhabungs- und Montagetechnik. 2017 Experiment 3: • 1)Hompel, Michael, Hubert Büchter, and Ulrich Franzke. Identifikationssysteme und Automatisierung. Springer-Verlag, 2007. • ArUco Library Documentation, https://docs.google.com/document/d/1QU9KoBtjSM2kF6lTOjQ76xqL7H0TEtXriJX5kwi9Kgc/edit Stand 10/21 • Demant, Christian, Bernd Streicher-Abel, and Axel Springhoff. Industrielle Bildverarbeitung: wie optische Qualitätskontrolle wirklich funktioniert. Springer-Verlag, 2011. Experiment 4: • 1)Will, Thorsten T. C++ Das umfassende Handbuch, Rheinwerk Computing, 2020 • 2)Hildebrand, Walter. Grundkurs Regelungstechnik : Grundlagen für Bachelorstudiengänge aller technischen Fachrichtungen und Wirtschaftsingenieure, Springer Vieweg, 2013. • 3)Erlenkötter, Helmut. C++: Objektorientiertes Programmieren von Anfang an, rororo, 2016

Course L1116: Measurement Technology for Mechanical Engineering	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	EN
Cycle	WiSe
Content	1 Fundamentals 1.1 Quantities and Units 1.2 Uncertainty 1.3 Calibration 1.4 Static and Dynamic Properties of Sensors and Systems 2 Measurement of Electrical Quantities 2.1 Current and Voltage 2.2 Impedance 2.3 Amplification 2.4 Oscilloscope 2.5 Analog-to-Digital Conversion 2.6 Data Transmission 3 Measurement of Nonelectric Quantities 3.1 Temperature 3.2 Length, Displacement, Angle 3.3 Strain, Force, Pressure 3.4 Flow 3.5 Time, Frequency
Literature	Lerch, R.: „Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren“, Springer, 2006, ISBN: 978-3-540-34055-3. Profos, P. Pfeifer, T.: „Handbuch der industriellen Messtechnik“, Oldenbourg, 2002, ISBN: 978-3486217940.

Course L1118: Measurement Technology for Mechanical Engineering	
Typ	Practical Course
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern
Language	EN
Cycle	WiSe/SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0853: Mathematics III

Courses

Title	Typ	Hrs/wk	CP
Analysis III (L1028)	Lecture	2	2
Analysis III (L1029)	Recitation Section (small)	1	1
Analysis III (L1030)	Recitation Section (large)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Differential Equations) (L1032)	Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1033)	Recitation Section (large)	1	1

Module Responsible	Prof. Marko Lindner
Admission Requirements	None
Recommended Previous Knowledge	Mathematics I + II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112
Credit points	8
Course achievement	None
Examination	Written exam
Examination duration and scale	60 min (Analysis III) + 60 min (Differential Equations 1)
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory

Course L1028: Analysis III	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of differential and integrational calculus of several variables • Differential calculus for several variables • Mean value theorems and Taylor's theorem • Maximum and minimum values • Implicit functions • Minimization under equality constraints • Newton's method for multiple variables • Fourier series • Double integrals over general regions • Line and surface integrals • Theorems of Gauß and Stokes
Literature	• http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1029: Analysis III	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1030: Analysis III	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1031: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of the theory and numerical treatment of ordinary differential equations • Introduction and elementary methods • Exsitence and uniqueness of initial value problems • Linear differential equations • Stability and qualitative behaviour of the solution • Boundary value problems and basic concepts of calculus of variations • Eigenvalue problems • Numerical methods for the integration of initial and boundary value problems • Classification of partial differential equations
Literature	• http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1032: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1033: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1013: Traffic systems and handling technology

Courses

Title	Typ	Hrs/wk	CP
Traffic systems and handling technology (L0715)	Lecture	2	3
Traffic systems and handling technology (L0718)	Recitation Section (small)	2	3

Module Responsible	Prof. Carlos Jahn
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: - explain and classify the terms and their meaning in transport and handling technology - reflect current political conditions and technical developments in transport and handling technology; - identify actors and their tasks in the maritime transport chain (pre-carriage, carriage, on-carriage); - determine, compare and assign suitable applications and areas of use of transport and handling techniques based on the questions: What will be transported? On what should it be transported? Where is the cargo to be handled? By which means?
Skills	Students can, on the basis of the knowledge they have acquired: - identify and evaluate key performance indicators (e.g. transport times, storage costs, etc.) in the maritime transport chain; - select and dimension suitable techniques for defined transport and handling tasks and critically evaluate approaches to solutions; - differentiate and evaluate transport and handling technologies (e.g. by calculating carbon footprints, transport times and costs for different modes of transport as well as point-to-point or hub-and-spoke freight transport in aviation).
Personal Competence	
Social Competence	Students are able to: - successfully and respectfully discuss and organise research tasks in small groups in the context of a comprehensive written elaboration during the semester and to present and represent them in a comprehensible way; - describe, differentiate and evaluate problems (e.g. in the joint compilation of factual knowledge on topics such as slow steaming in container shipping or the establishment of different maritime supply chains); - participate in technical discussions on topics from the transport and handling technology.
Autonomy	After completion of the module students capable to: - acquire knowledge of parts of the subject area independently and apply the acquired knowledge to solve new problems; - conduct a systematic literature search and record this in a scientific text; - critically reflect on the results of their own work.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory: No; Bonus: 10 %; Form: Written elaboration; Description:
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0715: Traffic systems and handling technology	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	In the course Transport Systems and Handling Technology the elementary basics, characteristics, possible applications and areas of expediency of transport and handling technology are taught. The students should be enabled to select, conceptualize and evaluate suitable techniques for defined transport and handling tasks. In addition to the goods to be transported and the loading units, the various means of transport, handling concepts and the necessary equipment play a special role. A basic knowledge of the relevant guidelines and standards is also built up. In addition to the transport systems road, rail, water (inland waterways and maritime shipping) and air transport, combined transport is also addressed. Contents of the lecture • Basics, possible applications, usefulnes of different transport and handling techniques • Overview of transported goods, loading units, means of transport, handling terminals and equipment • Representation of the modes of transport: road, rail, water (inland waterway, ocean-going vessel), air, combined transport
Literature	Clausen, Uwe; Geiger, Christiane (2013). Verkehrs- und Transportlogistik. Conrady, Roland; Fichert, Frank; Sterzenbach, Rüdiger (2019). Luftverkehr: Betriebswirtschaftliches Lehr- und Handbuch. Gleißner, Harald; Femerling, Christian (2012). Logistik: Grundlagen - Übungen - Fallbeispiele. Kranke, Andre; Schmied, Martin; Schön, Andrea D. (2011). CO2-Berechnung in der Logistik: Datenquellen, Formeln, Standards. Pachl, Jörn (2018). Systemtechnik des Schienenverkehrs: Bahnbetrieb planen, steuern und sichern. Rodrigue, Jean-Paul (2020). Geography of Transport Systems.

Course L0718: Traffic systems and handling technology	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	The exercise of the course Traffic Systems and Handling Technology is carried out as a guided group exercise. In the exercise sessions, students receive assignment sheets on the sub-topics of the course and work on these independently. The exercise sheets mainly consist of computational tasks as well as comprehension questions. The lecturers are available to the students during the exercise to discuss calculation methods and results. There is the possibility for students to earn 10-15% bonus points on their passed exam in the course of voluntary additional work, depending on the extent. For example, by working on the worksheets in small groups and handing them in. The classroom training can be supplemented by digital exercises.
Literature	Biebig , Peter; Althof, Wolfgang.; Wagener, Norbert (2008) Seeverkehrswirtschaft : Kompendium. 4. Auflage. Geisler, Alexander; Johns, Dirk Max (2018): See Schiff Ladung: Fachbuch für Schifffahrtskaufleute: von Praktikern für Praktiker, 2. Auflage. Bänsch, Axel; Alewell, Dorothea; Moll, Tobias (2020): Wissenschaftliches Arbeiten, 12. Auflage. Voss, Rüdiger (2019): Wissenschaftliches Arbeiten: … leicht verständlich. 6. Auflage.

Module M1112: Production Logistics

Courses

Title	Typ	Hrs/wk	CP
Production Logistics Seminar (L1253)	Seminar	2	6

Module Responsible	Prof. Thorsten Blecker
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Knowledge: Students will have acquired knowledge in the following areas: • interaction of production and logistics and interdependencies • production-related logistics topics
Skills	Skills: Students will based on the acquired knowledge be in a position to • assess issues on production logistics • to be able to deal critically with developments in production logistics and assess these critically; • to work independently on current topics from the field of "production logistics";
Personal Competence	
Social Competence	Social competence: After completing the module students are capable of • to conduct subject-specific and interdisciplinary discussions; • present orally and in writing their results; • respectful team work
Autonomy	After completing the module students are capable to work independently on a subject and transfer the acquired knowledge to new problems.
Workload in Hours	Independent Study Time 152, Study Time in Lecture 28
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	approx. 20 pages plus presentation (20 minutes per person)
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1253: Production Logistics Seminar

Typ	Seminar
Hrs/wk	2
CP	6
Workload in Hours	Independent Study Time 152, Study Time in Lecture 28
Lecturer	Prof. Thorsten Blecker
Language	DE
Cycle	WiSe
Content	Within the Production Logistics Seminar the students shall compose a first term paper. In the beginning production-close logstic topics will be distributed which the students have to elaborate on their own. This workshop aims at the better motivation of the students to structure new and creative ideas and develop them to innovative solutions. This workshop contains regular meetings as well as two presentations in the middle and at the end.
Literature	Skripte und Textdokumente, die während der Vorlesung herausgegeben werden.

Module M0833: Introduction to Control Systems

Courses

Title	Typ	Hrs/wk	CP
Introduction to Control Systems (L0654)	Lecture	2	4
Introduction to Control Systems (L0655)	Recitation Section (small)	2	2

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems • They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus • They can explain the Nyquist stability criterion and the stability margins derived from it. • They can explain the role of the phase margin in analysis and synthesis of control loops • They can explain the way a PID controller affects a control loop in terms of its frequency response • They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	• Students can transform models of linear dynamic systems from time to frequency domain and vice versa • They can simulate and assess the behavior of systems and control loops • They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules • They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques • They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation • They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0654: Introduction to Control Systems	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Signals and systems • Linear systems, differential equations and transfer functions • First and second order systems, poles and zeros, impulse and step response • Stability Feedback systems • Principle of feedback, open-loop versus closed-loop control • Reference tracking and disturbance rejection • Types of feedback, PID control • System type and steady-state error, error constants • Internal model principle Root locus techniques • Root locus plots • Root locus design of PID controllers Frequency response techniques • Bode diagram • Minimum and non-minimum phase systems • Nyquist plot, Nyquist stability criterion, phase and gain margin • Loop shaping, lead lag compensation • Frequency response interpretation of PID control Time delay systems • Root locus and frequency response of time delay systems • Smith predictor Digital control • Sampled-data systems, difference equations • Tustin approximation, digital implementation of PID controllers Software tools • Introduction to Matlab, Simulink, Control toolbox • Computer-based exercises throughout the course
Literature	• Werner, H., Lecture Notes „Introduction to Control Systems“ • G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 • K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 • R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1289: Logistical systems - Industry 4.0

Courses

Title	Typ	Hrs/wk	CP
Logistics systems - Industry 4.0 (L1753)	Seminar	4	6

Module Responsible	Prof. Jochen Kreutzfeldt
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of the module „Technical Logistics“
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to understand and explain the concept "Logistical System". 2. The students are able to design a logistic system conceptually. 3. The students can develop and implement the control of a logistic system with python.
Skills	The students will acquire the following skills: 1. The students are able to identify logistical systems, analyze and identify potential for change and improvement. 2. The students know different technical solutions to address problems in logistical systems. 3. The students are capable of deploying technical solutions and ideas from the concept Industry 4.0 to deal with logistical problems.
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students are able to develop technical solutions for logistical systems and reflect their contribution within the team. 2. The technical solutions from the group can be jointly documented and presented. 3. Students are able to present their technological solutions to an audience and derived from the critique new ideas and improvements.
Autonomy	The students will acquire the following independent competencies: 1. The students can independently develop technical solutions for logistical problems under supervision. 2. The students are able to evaluate their technical solutions and discuss the pros and cons. 3. The students are able to assess the impact of the concept Industry 4.0 on their own career development.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Lab prototype with documentation (group work)
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1753: Logistics systems - Industry 4.0	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Jochen Kreutzfeldt
Language	DE
Cycle	WiSe
Content	The lecture gives an introduction to the concept of logistical systems with a special emphasis on the subject of Industry 4.0. Here, the system concept in logistics from a technical point of view is introduced. A logistical system is understood as a combination of transport, storage and change processes between source and sink of goods. This lecture will look at the technical aspect of these processes. Industry is a topic of this lecture. Industry 4.0 is understood as the far-reaching digitization and networking of logistical systems and the connection of logistical objects, processes and systems. The logistics industry expects Industry 4.0 to be a profound change and the realization of large improvement potentials. The lecture provides an in-depth introduction to application cases and business models of Industry 4.0 in logistics from a technical standpoint. A possible framework for Industry 4.0 is presented and several application examples are shown. In the exercises, students learn will learn the exemplary use of different technical solutions and know how, which can be used to improve logistical systems.
Literature	Bauernhansl, Thomas et al. (2014): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Wiesbaden: Springer Vieweg. Hausladen, Iris (2014): IT-gestützte Logistik. Systeme - Prozesse - Anwendungen. 2. Auflage 2014. Wiesbaden: Imprint: Gabler Verlag. Hompel, Michael ten; Büchter, Hubert; Franzke, Ulrich (2008): Identifikationssysteme und Automatisierung. [Intralogistik]. Berlin, Heidelberg: Springer. Kaufmann, Timothy (2015): Geschäftsmodelle in Industrie 4.0 und dem Internet der Dinge. Der Weg vom Anspruch in die Wirklichkeit. Wiesbaden: Springer Fachmedien Wiesbaden. Martin, Heinrich (2014): Transport- und Lagerlogistik. Planung, Struktur, Steuerung und Kosten von Systemen der Intralogistik. 9., Auflage 2014. Wiesbaden: Imprint: Springer Vieweg. Runkler, Thomas A. (2010): Data-Mining. Methoden und Algorithmen intelligenter Datenanalyse. 1. Aufl. Wiesbaden: Vieweg + Teubner (Studium).

Module M1349: Object-oriented programming in logistics

Courses

Title	Typ	Hrs/wk	CP
Object-oriented programming in logistics (L1901)	Seminar	4	6

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Basic computer skills Computer Science for Engineers - Introduction and Overview
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to explain the basics of object-oriented programming with Java. 2. The students know basic data types, control structures and basic concepts of object orientation and inheritance in the Java programming language. 3. The students know the necessary tools for programming with Java.
Skills	The students will acquire the following skills: 1. The students will be able to develop and run programs with Java independently. 2. The students will be able to develop and implement own objects and classes with Java. 3. The students are able to identify and overcome failures autonomously (debugging).
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students can explain self-developed programs to other students. 2. The students can support others in finding failures and mistakes in their software-code. 3. The students are able to present their programs in front of a audience.
Autonomy	The students will acquire the following competencies: 1. The students work independently with an initially unknown programming language (Java). 2. The students are able to derive independently the necessary source code for a given problem. 3. The students are able to write their own source code in Java based on given a problem.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1901: Object-oriented programming in logistics	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	NN
Language	DE
Cycle	WiSe
Content	The seminar provides an introduction to object-oriented programming with Java. Practical knowledge will be transferred through programming exercises parallel to theoretical content. The exercises will deal mainly with logistical problems. The seminar will be conducted as an integrated seminar with a combination of theoretical content and autonomously solved programming problems on the computer. Furthermore, the student will become familiar with the standard libraries of Java and their properties and functions. These standard objects will be used, if necessary with the assistance of an instructor, to build own programs. Furthermore, an introduction to the actual software development kits (SDK) of Java will be given.
Literature	Goll, Joachim; Heinisch, Cornelia (2014): Java als erste Programmiersprache. Ein professioneller Einstieg in die Objektorientierung mit Java. 7. Aufl. 2014. Wiesbaden: Imprint: Springer Vieweg. Jobst, Fritz (2015): Programmieren in Java. [aktuell zu Java 8]. 7., vollst. überarb. Aufl. München: Hanser. Abts, Dietmar (2015): Grundkurs JAVA. Von den Grundlagen bis zu Datenbank- und Netzanwendungen. 8. Aufl. Wiesbaden: Springer Vieweg.

Module M1070: Simulation of Transport and Handling Systems

Courses

Title	Typ	Hrs/wk	CP
Simulation of Transport and Handling Systems (L1352)	Lecture	1	2
Simulation of Transport and Handling Systems (L1818)	Recitation Section (small)	3	4

Module Responsible	Prof. Carlos Jahn
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of transport- and handlingtechnology.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can... • Explain the structure and workings of standard external logistics systems. • Outline the benefits of using simulation software subject to the starting situation. • Present different simulation programs and kinds of simulation that are in widespread use and explain their characteristics.
Skills	Students are able to... • Recognize, analyze, and assemble into a model the elementary building blocks of a logistics system. • Map complex external logistics process using the *Plant Simulation*® simulation software. • Draw inferences from the results of the simulation, transfer them to the reality, and deduce action recommendations from them.
Personal Competence	
Social Competence	Students are capable of... • Solving complex tasks in a team and to document assignments accordingly. • Playing different roles in the teamwork and giving each other appropriate feedback in the team. • Presenting the relevant results of their project to specialists and representing them.
Autonomy	Students are able... • To acquaint themselves independently with software with which they are not familiar and to use it to solve complex tasks. • To define work steps independently and to acquire the knowledge required to do so.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Subject theoretical and practical work
Examination	Subject theoretical and practical work
Examination duration and scale	Simulation study and report with approximately 15 pages per person
Assignment for the Following Curricula	Data Science: Core Qualification: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1352: Simulation of Transport and Handling Systems	
Typ	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	The lecture deals with the simulation of external logistics systems. The focus is therefore on the consideration of logistical processes between companies or on transhipment systems, such as ports or individual terminals. In the first part of the lecture, students will first acquire basic knowledge of external logistics systems and the advantages of using simulations to present them. Then an overview of existing simulation types and programs is given and examples for existing simulation models of logistic systems in science and practice are shown. Some simulation models will be demonstrated. In the second part of the lecture the students learn the basic handling of the simulation software Plant Simulation®. They receive theoretical explanations of the general functionality of the simulation tool, which are further deepened through the use of extensive, interactive examples. At the same time, five exercises, which build on each other, offer students the opportunity to implement the course content they have learnt alone and in small groups. The exercises can be completed during the supervised lecture periods as well as at other times. The acquired knowledge is to be applied in the third part in the course of group work. The students will be divided into groups, each of which will then work on a relevant problem from the field of (external) logistic systems by means of simulation. The students are given a defined period of time for their work. During this time at least one person is always available for questions and suggestions. The results of the group work are to be documented in a simulation report and handed in at the end of the processing time. Finally, the individual groups present the problems they have worked on and their results in a presentation.
Literature	Bangsow, Steffen (2011): Praxishandbuch Plant Simulation und SimTalk. Anwendung und Programmierung in über 150 Beispiel-Modellen. München: Hanser Verlag. Eley, Michael (2012): Simulation in der Logistik. Einführung in die Erstellung ereignisdiskreter Modelle unter Verwendung des Werkzeuges "Plant Simulation". Berlin, Heidelberg: Springer. Engelhardt-Nowitzki, Corinna; Nowitzki, Olaf; Krenn, Barbara (2008): Management komplexer Materialflüsse mittels Simulation. State-of-the-Art und innovative Konzepte. Wiesbaden: Deutscher Universitäts-Verlag / GWV Fachverlage GmbH, Wiesbaden. Rabe, Markus; Spieckermann, Sven; Wenzel, Sigrid (2008): Verifikation und Validierung für die Simulation in Produktion und Logistik. Vorgehensmodelle und Techniken. Berlin, Heidelberg: Springer. Sargent, Robert G. (2010): Verification and Validation of Simulation Models. In: B. Johansson, S. Jain, J. Montoya-Torres, J. Hugan, and E. Yücesan, eds.: Proceedings of the 2010 Winter Simulation Conference. VDI-Richlinie: VDI 3633. Simulation von Logistik-, Materialfluß-und Produktionssystemen Wenzel, Sigrid; Rabe, Markus; Spieckermann, Sven (2006): Verifikation und Validierung für die Simulation in Produktion und Logistik. Vorgehensmodelle und Techniken. 1. Aufl. Berlin: Springer Berlin.

Course L1818: Simulation of Transport and Handling Systems	
Typ	Recitation Section (small)
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0980: Logistics, Transport and Environment

Courses

Title	Typ	Hrs/wk	CP
Logistics, Transport and Environment (L0009)	Project-/problem-based Learning	2	4
Environmental Management and Corporate Responsibilty (L1160)	Seminar	2	2

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	• Introduction to logistics and mobility • Foundations of Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • explain basic terms of transport logistics, commercial traffic, transport policy and sustainability • describe actors and system boundaries, challenges and goals of transport logistics • reflect standards of sustainability management
Skills	Students are able to... • design logistics systems independently • differentiate sustainability, CR, CSR and environmental management • critically evaluate measures for sustainable logistics and develop them
Personal Competence	
Social Competence	Students can... • creatively develop solutions in teams and work out presentations • present their knowledge and skills to other students
Autonomy	Students can... • carry out small research studies independently • apply theoretical knowledge in practical projects • apply presentation techniques such as free speech, designing charts (i.e. in Power-Point), use of media (Flip-Charts, Whiteboard, Metaplan)
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Written assignment with short presentation
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L0009: Logistics, Transport and Environment	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	Application and creative development of professional knowledge within the framework of the case study "Environmental impacts of supply chains" using a specific company as example. Depending on the chosen focus of the academic year: • characteristics of different transport systems • technologies, structures and processes of transport logistics systems (nodes, network, interactions) • location and route planning • connections of information flow and material flows in transport chains • interrelation between private and private (contract logistics) and private and public (business policy, transport policy) and their (diverging) • design approaches for sustainable logistics
Literature	Ihde, Gösta B.: Transport, Verkehr, Logistik. Gesamtwirtschaftliche Aspekte und einzelwirtschaftliche Handhabung. 3. überarbeitete Auflage. Vahlen, München 2001

Course L1160: Environmental Management and Corporate Responsibilty	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	• Imparting knowledge about standards (e.g. EMAS and ISO 14.001) as important methodological approaches for the integration of environmental and sustainability management in business companies • Explaination of theoretical concepts of corporate sustainability management • Imparting pracitical knowledge from different stakeholder views: consulting company, trading enterprise, NGO, financial market
Literature	--

Module M0610: Electrical Machines and Actuators

Courses

Title	Typ	Hrs/wk	CP
Electrical Machines and Actuators (L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2

Module Responsible	Prof. Thorsten Kern
Admission Requirements	None
Recommended Previous Knowledge	Basics of mathematics, in particular complexe numbers, integrals, differentials Basics of electrical engineering and mechanical engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can to draw and explain the basic principles of electric and magnetic fields. They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the driven engine.
Skills	Students are able to calculate two-dimensional electric and magnetic fields in particular ferromagnetic circuits with air gap. For this they apply the usual methods of the design auf electric machines. They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.
Personal Competence	
Social Competence	none
Autonomy	Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse independently the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantities and characteristic curves.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Design of four machines and actuators, review of design files
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Specialisation Electrical Engineering: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Elective Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Electrical Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0293: Electrical Machines and Actuators	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation, Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands´diagram), torque vs. speed characteristics, rotor layout (squirrel-cage vs. sliprings), Drives with variable speed, inverter fed operation, special drives
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"

Course L0294: Electrical Machines and Actuators	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1290: Simulation of intra logistics

Courses

Title	Typ	Hrs/wk	CP
Simulation of intra logistics (L1755)	Seminar	4	6

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of the module „Technical Logistics“
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to explain the significance, the structure and the components of an event- and object-oriented simulation model in intralogistics. 2. The students are able to reflect and explain the process of creating and programming an event- and object-oriented simulation model in intralogistics. 3. The students are able to view critically the strengths and weaknesses of event- and object-oriented simulation model.
Skills	The students will acquire the following skills: 1. The students will be able to derive the necessary parameters for the development of an event- and object-oriented simulation model in intralogistics from an existing logistics system. 2. The students will be able to program and run Plant Simulation simulation models independently. 3. The students can evaluate and interpret the results from a simulation model.
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students are able to develop a complex simulation model in a team. 2. The students know the different roles in joint development of a simulation model and can give feedback to their respective roles. 3. The students are able to process the simulation results and present them in front of a audience.
Autonomy	The students will acquire the following independent competencies: 1. The students work independently in an initially unknown software (Plant Simulation). 2. The students are able to derive independently the necessary simulation parameters from information about a logistics system. 3. The students are able to develop and program an event- and object-oriented simulation models from given parameters.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L1755: Simulation of intra logistics	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	NN
Language	DE
Cycle	SoSe
Content	The seminar provides an introduction to the development and programming of event and object-oriented simulation models based on the Plant Simulation software. The simulation models are focused on issues and problems in the field of intralogistics. The seminar will be conducted as a combination of theoretical content and autonomously solving simulation tasks on the computer. The students learn the ideal development workflow, programming and evaluation of a simulation model. Furthermore, the student will become familiar with the standard objects of a simulation model in Plant Simulation and their properties and functions. These standard objects will be used, if necessary with the assistance of the instructor, to build simulation models and analyze and evaluate the results. Furthermore, an introduction to the individual programming of simulation models is given on the basis of Sim Talk language.
Literature	Bangsow, Steffen (2011): Praxishandbuch Plant Simulation und SimTalk, Hanser Verlag, München. Bangsow, Steffen (2015): Tecnomatix plant simulation : modeling and programming by means of examples, Springer, Berlin. Eley, Michael (2012): Simulation in der Logistik : Einführung in die Erstellung ereignisdiskreter Modelle unter Verwendung des Werkzeuges "Plant Simulation", Springer, Berlin.

Module M1014: Logistics Service Provider Management

Courses

Title	Typ	Hrs/wk	CP
Logistics Service Provider Management (L1240)	Seminar	3	6

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	• Introduction to Logistics and Mobility • Transport and cross-docking Technology • Logistics Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • integrate LSPs into the concept of business logistics • tell the specifics of business services and logistics Services and their derived characteristics • describe logistics functions as LSP service packages • explain, why companies outsource logistics Services and what are actual trends in Business • describe basic outsorucing processes and tender management success factors • describe and analyze intra- and intermodal transport institutions as well as tasks, challenges and opportunities for the Management of LSPs
Skills	Students can... • support the sub-segment specific business functions and management Tasks (e.g. for Road Transport, Airlines, SeaPort Providers etc.) • categorize LSPs regarding strategic product-market-positioning • derive action plans regarding management tasks depending on contigencies
Personal Competence	
Social Competence	Students can... • discuss case studies in Groups (within and outside of the classroom), reaching a common understanding and result • prepare and deliver Business presentations • give and discuss Feedbacks in the large group
Autonomy	Students can... • produce written reports independently
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	2 scientific written papers of approx. 20 pages each. Presentation (approx. 15 pages) with 20-minute closing lecture in groups of 3 to max. 5 persons. Grading of 4 partial grades of 25% each (2 seminar papers, 2 presentation documents) individually per group member.
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1240: Logistics Service Provider Management	
Typ	Seminar
Hrs/wk	3
CP	6
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Lecturer	Prof. Stephan Freichel
Language	DE
Cycle	SoSe
Content	**1 Concept and Functions** Define the role of logistics services providers in the overall concept and functions of logistics services providers. Workshop on the role of logistics services providers in the economy, based on up-to-date topics in the field and in the news. **2 Outsourcing and Cooperation** Make or buy, forms and management of inter-organizational relations **3 Institutions** Special business management features of carriers, haulage contractors, CEP services **4 Trends, Strategies and Management Functions** Market trends, requirements, basic business management and management functions (operations, business development, HR, IT, finance/planning and control, organization, leadership) **5 Strategic Developments and Case Studies** Selected aspects (e.g. risk and innovation management, global and regional networking, greenwashing and sustainability) Examples: Case Study A) Types of company (such as haulage contractors, railway operators, road transport companies, heavy goods, textile and refrigerated goods specialists, CEPs, etc) will be introduced and discussed in the context of a presentation. Case Study B) Individual companies will be analyzed on the basis of accessible material such as company reports, websites and possibly telephone interviews and case studies will be explained and discussed with regard to the functions of the logistics services provider and the management task of the corporate managements of the selected cases.
Literature	Pfohl, H.-Chr.: Logistiksysteme. Betriebswirtschaftliche Grundlagen. 8., neu bearbeite und aktualisierte Auflage, Berlin u.a. 2009 Eßig, M. / Hofmann, E. / Stölzle, W.: Supply Chain Management. München 2013. Freichel, S.L.K.: Organisation von Logistikservice-Netzwerken. Reihe: Logistik und Unternehmensführung, hrsg. von Prof. Dr. H.-Chr. Pfohl, Bd. 4. Berlin 1993. Aberle, G.: Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 4. überarbeitete und erweiterte Auflage, München/Wien 2006. Buchholz, J./Clausen, U./Vastag, A. (Hrsg): Handbuch der Verkehrslogistik, Heidelberg 1998. Corsten, H.: Dienstleistungsmanagement, 3. Auflage, München 1997. Müller-Daupert, B. (Hrsg.): Logistik-Outsourcing, 2. Auflage, München, Vogel, 2009 Ihde, G. B.: Transport, Verkehr, Logistik. Gesamtwirtschaftliche Aspekte und einzelwirtschaftliche Handhabung, 3. völlig überarb. und erw. Auflage, München 2001. van Suntum, U.: Verkehrspolitik, München 1986.

Specialization Traffic Planning and Systems

Module M1897: New Technologies and Markets

Courses

Title	Typ	Hrs/wk	CP
Data-driven marketing and sales (L3138)	Lecture	3	4
New technologies and market opportunities (L3139)	Project-/problem-based Learning	1	2

Module Responsible	Prof. Christian Lüthje
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Written elaboration, exercises, presentation, oral participation
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L3138: Data-driven marketing and sales

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	
Literature	

Course L3139: New technologies and market opportunities

Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Christian Lüthje
Language	DE
Cycle	SoSe
Content	
Literature	

Module M0986: Introduction to Transportation Economics

Courses

Title	Typ	Hrs/wk	CP
Introduction to Transportation Economics (L1188)	Lecture	3	6

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • explain basic connections between transport, traffic and logistics • explain the macroeconomic relevance of logistics • state the relevance of different modes of transport for the economy • describe the development and challenges of transport policy • explain trends and developments in transport industry
Skills	Based on their gained knowledge students can develop ideas for political decisions and design questions in the transport industry.
Personal Competence	
Social Competence	Students can discuss small tasks in groups and find solutions together.
Autonomy	Students are able to solve small tasks on their own with given literature.
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	60 minutes
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory

Course L1188: Introduction to Transportation Economics

Typ	Lecture
Hrs/wk	3
CP	6
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Lecturer	Karl Michael Probst
Language	DE
Cycle	SoSe
Content	• Functions of transport • Macroeconomic developments of transport • Special characteristics of transport • Transport infrastructure policy • International transport policy • Transport policy in the EU • External costs of transport • Market entry into transport markets
Literature	--

Module M0983: Mobility Concepts

Courses

Title	Typ	Hrs/wk	CP
Mobility Research and Transportation Projects (L1181)	Project-/problem-based Learning	3	3
Mobility in Megacities and Developing Countries (L1182)	Seminar	3	3

Module Responsible	Dr. Philine Gaffron
Admission Requirements	None
Recommended Previous Knowledge	Module Transportation Planning and Traffic Engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: • name the different urban transport systems existing around the world. • explain the transport challenges in Asian and African mega cities. • recognise and relate interactions between transport systems on the one hand and ecological, socio-cultural and economic problem areas on the other. • outline specific issues and problems in urban development and transport (in Germany and developing countries). • explain the effects of external framework factors (like energy costs) on transport.
Skills	Students are able to: • analyse and evaluate given case studies. • transfer learning results to other regions and cities. • analyse specific issues and problems in urban development and transport (in developing countries). • critically assess actors, planning objectives, planned measures and the implementation of transport projects in the light of the UN Millennium Development Goals • develop and present sustainable (i.e. ecological, poverty oriented, gender balanced and economical) solutions for urban personal and goods transport
Personal Competence	
Social Competence	Students are able to: • present and explain independently generated findings. • constructively discuss potentially controversial topics in a group context.
Autonomy	Students are able to: • carry out independent literature research and analysis. • independently author a written report on a given topic.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / None / Participation in excursions / Exkursion innerhalb Hamburgs abhängig von aktuellen Themen im Modul
Examination	Written elaboration
Examination duration and scale	All assignments in groups (2-4 students): written report, 2000 words (incl. 2 short presentations of 10 mins.); final presentation, 20 mins. plus discussion (incl. slides) and 1000 word report incl. peer review (individual).
Assignment for the Following Curricula	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory

Course L1181: Mobility Research and Transportation Projects	
Typ	Project-/problem-based Learning
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Philine Gaffron
Language	DE
Cycle	SoSe
Content	This course places its focus on transport and mobility in Germany. It deals with questions such as: • Which external factors - like e.g. energy costs, availability of renewable and fossil fuels, environmental and climate protection objectives - influence current developments in the transport sector? • Which external effects in turn are caused by mobility choices and traffic? • How should these interactions be evaluated, how and by whom can they be influenced? • Which measures at the municipal level can contribute to a more sustainable transport system? During the course, these questions will be illustrated and discussed with reference to different examples and current developments. Participants will also provide input on specific topics. Potential core subjects of the course could be: • Environmental Justice : which population groups are disproportionately affected by transport emissions and who causes them? • Municipal cycle planning • Transport and Climate Protection: can, want, act - everything could be, nothing must be?
Literature	Die Literaturempfehlungen sind abhängig von den jeweiligen, wechselnden Themenschwerpunkten und werden rechtzeitig vor Beginn der Veranstaltung bekannt gegeben.

Course L1182: Mobility in Megacities and Developing Countries	
Typ	Seminar
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Jürgen Perschon, Christof Hertel
Language	DE
Cycle	SoSe
Content	The course provides and overview over different transport projects in the metropolitan areas of developing countries. Considering different perspectives on urban growth, social justice, economic development, environmental and climate protection as well as the economic viability of public transport, the specific situation in the urban conglomerates of Asia, Latin America and Africa will be analysed and placed in a regional and global context. Specific public transport systems will be examined to establish, whether they are a suitable example for sustainable urban development. The following examples could be suitable case studies: Singapore (Metro), Lagos (BRT Light), Guanghzou, Bogota, Jakarta (Full BRT), Sao Paulo, Medellin (Cable Car Systems), Johannesburg (Minibus-Taxi). The course will be designed interactively with the students and will partly be in English as is the majority of the literature in this area (also: Skype online interviews with international experts in the transport sector). **An English language presentation is also part of the course work.**
Literature	--

Module M1013: Traffic systems and handling technology

Courses

Title	Typ	Hrs/wk	CP
Traffic systems and handling technology (L0715)	Lecture	2	3
Traffic systems and handling technology (L0718)	Recitation Section (small)	2	3

Module Responsible	Prof. Carlos Jahn
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to: - explain and classify the terms and their meaning in transport and handling technology - reflect current political conditions and technical developments in transport and handling technology; - identify actors and their tasks in the maritime transport chain (pre-carriage, carriage, on-carriage); - determine, compare and assign suitable applications and areas of use of transport and handling techniques based on the questions: What will be transported? On what should it be transported? Where is the cargo to be handled? By which means?
Skills	Students can, on the basis of the knowledge they have acquired: - identify and evaluate key performance indicators (e.g. transport times, storage costs, etc.) in the maritime transport chain; - select and dimension suitable techniques for defined transport and handling tasks and critically evaluate approaches to solutions; - differentiate and evaluate transport and handling technologies (e.g. by calculating carbon footprints, transport times and costs for different modes of transport as well as point-to-point or hub-and-spoke freight transport in aviation).
Personal Competence	
Social Competence	Students are able to: - successfully and respectfully discuss and organise research tasks in small groups in the context of a comprehensive written elaboration during the semester and to present and represent them in a comprehensible way; - describe, differentiate and evaluate problems (e.g. in the joint compilation of factual knowledge on topics such as slow steaming in container shipping or the establishment of different maritime supply chains); - participate in technical discussions on topics from the transport and handling technology.
Autonomy	After completion of the module students capable to: - acquire knowledge of parts of the subject area independently and apply the acquired knowledge to solve new problems; - conduct a systematic literature search and record this in a scientific text; - critically reflect on the results of their own work.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory: No; Bonus: 10 %; Form: Written elaboration; Description:
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0715: Traffic systems and handling technology	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	In the course Transport Systems and Handling Technology the elementary basics, characteristics, possible applications and areas of expediency of transport and handling technology are taught. The students should be enabled to select, conceptualize and evaluate suitable techniques for defined transport and handling tasks. In addition to the goods to be transported and the loading units, the various means of transport, handling concepts and the necessary equipment play a special role. A basic knowledge of the relevant guidelines and standards is also built up. In addition to the transport systems road, rail, water (inland waterways and maritime shipping) and air transport, combined transport is also addressed. Contents of the lecture • Basics, possible applications, usefulnes of different transport and handling techniques • Overview of transported goods, loading units, means of transport, handling terminals and equipment • Representation of the modes of transport: road, rail, water (inland waterway, ocean-going vessel), air, combined transport
Literature	Clausen, Uwe; Geiger, Christiane (2013). Verkehrs- und Transportlogistik. Conrady, Roland; Fichert, Frank; Sterzenbach, Rüdiger (2019). Luftverkehr: Betriebswirtschaftliches Lehr- und Handbuch. Gleißner, Harald; Femerling, Christian (2012). Logistik: Grundlagen - Übungen - Fallbeispiele. Kranke, Andre; Schmied, Martin; Schön, Andrea D. (2011). CO2-Berechnung in der Logistik: Datenquellen, Formeln, Standards. Pachl, Jörn (2018). Systemtechnik des Schienenverkehrs: Bahnbetrieb planen, steuern und sichern. Rodrigue, Jean-Paul (2020). Geography of Transport Systems.

Course L0718: Traffic systems and handling technology	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	The exercise of the course Traffic Systems and Handling Technology is carried out as a guided group exercise. In the exercise sessions, students receive assignment sheets on the sub-topics of the course and work on these independently. The exercise sheets mainly consist of computational tasks as well as comprehension questions. The lecturers are available to the students during the exercise to discuss calculation methods and results. There is the possibility for students to earn 10-15% bonus points on their passed exam in the course of voluntary additional work, depending on the extent. For example, by working on the worksheets in small groups and handing them in. The classroom training can be supplemented by digital exercises.
Literature	Biebig , Peter; Althof, Wolfgang.; Wagener, Norbert (2008) Seeverkehrswirtschaft : Kompendium. 4. Auflage. Geisler, Alexander; Johns, Dirk Max (2018): See Schiff Ladung: Fachbuch für Schifffahrtskaufleute: von Praktikern für Praktiker, 2. Auflage. Bänsch, Axel; Alewell, Dorothea; Moll, Tobias (2020): Wissenschaftliches Arbeiten, 12. Auflage. Voss, Rüdiger (2019): Wissenschaftliches Arbeiten: … leicht verständlich. 6. Auflage.

Module M0608: Basics of Electrical Engineering

Courses

Title	Typ	Hrs/wk	CP
Basics of Electrical Engineering (L0290)	Lecture	3	4
Basics of Electrical Engineering (L0292)	Recitation Section (small)	2	2

Module Responsible	Prof. Thorsten Kern
Admission Requirements	None
Recommended Previous Knowledge	Basics of mathematics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can to draw and explain circuit diagrams for electric and electronic circuits with a small number of components. They can describe the basic function of electric and electronic componentes and can present the corresponding equations. They can demonstrate the use of the standard methods for calculations.
Skills	Students are able to analyse electric and electronic circuits with few components and to calculate selected quantities in the circuits. They apply the ususal methods of the electrical engineering for this.
Personal Competence	
Social Competence	Students are enabled to collaborate in interdisciplinary teams with electrical engineering as a common language With this, they are learning communication in a target-oriented communication style, are able to understand interfaces to neighboring engineering disciplines and learn about commonalities but also limits in the different directions of engineering.
Autonomy	Students are able independently to analyse electric and electronic circuits and to calculate selected quantities in the circuits.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Subject theoretical and practical work / Während des Semesters werden Hausarbeiten in Form von elektrischen Aufgaben vergeben, für die durch Simulation eine Lösung entwickelt und nachgewiesen werden muss.
Examination	Subject theoretical and practical work
Examination duration and scale	135 minutes
Assignment for the Following Curricula	Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0290: Basics of Electrical Engineering

Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern
Language	DE
Cycle	WiSe
Content	DC networks: Current, voltage, power, Kirchhoff's laws, equivalent sources, network analysis AC: Characteristics, RMS, complexe representation, phasor diagrams, power Three phase AC: Characterisitics, star-delta- connection, power, transformer Elektronics: Principle, operating behaviour and application of electronic devises as diode, Zener-diode, thyristor, transistor operational amplifier
Literature	Alexander von Weiss, Manfred Krause: "Allgemeine Elektrotechnik"; Viweg-Verlag, Signatur der Bibliothek der TUHH: ETB 309 Ralf Kories, Heinz Schmitt - Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - andere Autoren

Course L0292: Basics of Electrical Engineering	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Weitere Mitarbeiter
Language	DE
Cycle	WiSe
Content	Excercises to the analysis of circuits and the calculation of electrical quantities th the topics: DC networks: Current, voltage, power, Kirchhoff's laws, equivalent sources, network analysis AC: Characteristics, RMS, complexe representation, phasor diagrams, power Three phase AC: Characterisitics, star-delta- connection, power, transformer Elektronics: Principle, operating behaviour and application of electronic devises as diode, Zener-diode, thyristor, transistor operational amplifier
Literature	Alexander von Weiss, Manfred Krause: "Allgemeine Elektrotechnik"; Viweg-Verlag, Signatur der Bibliothek der TUHH: ETB 309 Ralf Kories, Heinz Schmitt - Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - andere Autoren

Module M0740: Structural Analysis I

Courses

Title	Typ	Hrs/wk	CP
Structural Analysis I (L0666)	Lecture	2	3
Structural Analysis I (L0667)	Recitation Section (large)	2	2
Structural Analysis I (L3133)	Recitation Section (small)	1	1

Module Responsible	Prof. Bastian Oesterle
Admission Requirements	None
Recommended Previous Knowledge	Mechanics I, Mathematics I
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	After successfully completing this module, students can express the basic aspects of linear frame analysis of statically determinate and indeterminate systems.
Skills	After successful completion of this module, the students are able to distinguish between statically determinate and indeterminate structures. They are able to analyze state variables and to construct influence lines of statically determinate plane and spatial frame and truss structures.
Personal Competence	
Social Competence	Students can • participate in subject-specific and interdisciplinary discussions, • defend their own work results in front of others • promote the scientific development of colleagues • Furthermore, they can give and accept professional constructive criticism
Autonomy	The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: No; Bonus: 10 %; Form: Written elaboration; Description: Hausübungen mit Testat, betreut durch Studentische Tutoren (Tutorium)
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0666: Structural Analysis I

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Bastian Oesterle
Language	DE
Cycle	WiSe
Content	• modeling of structures • theory of plane and spacial structures • assessment of structural behaviour, degree of static indeterminacy and kinematics • analysis of forces and moments, as well as diplscements and rotations • principle of virtual work • influence lines • Force Method for statically indeterminate structures
Literature	• Vorlesungsmanuskript • Bletzinger et al.: Aufgabensammlung zur Baustatik: Übungsaufgaben zur Berechnung ebener Stabtragwerke. Hanser. • Dinkler: Grundlagen der Baustatik. Springer. • Marti: Baustatik. Ernst und Sohn.

Course L0667: Structural Analysis I	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bastian Oesterle
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L3133: Structural Analysis I	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bastian Oesterle
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1890: Strategic Management of Technological Innovation

Courses

Title	Typ	Hrs/wk	CP
Strategic Management of Technological Innovation (L3127)	Lecture	3	3
Strategic Management of Technological Innovation (L3128)	Project-/problem-based Learning	2	3

Module Responsible	Prof. Tim Schweisfurth
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence *Knowledge* *Skills* **Personal Competence** *Social Competence* *Autonomy*	
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	Compulsory: Yes; Bonus: 20 %; Form: Subject theoretical andsemesterbegleitende practical work; Description: Mini-Tests, Gruppenarbeiten
Examination	Written exam
Examination duration and scale	60 minutes
Assignment for the Following Curricula	Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L3127: Strategic Management of Technological Innovation

Typ	Lecture
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Tim Schweisfurth
Language	EN
Cycle	WiSe
Content	
Literature	

Course L3128: Strategic Management of Technological Innovation

Typ	Project-/problem-based Learning
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Tim Schweisfurth
Language	EN
Cycle	WiSe
Content	
Literature	

Module M0853: Mathematics III

Courses

Title	Typ	Hrs/wk	CP
Analysis III (L1028)	Lecture	2	2
Analysis III (L1029)	Recitation Section (small)	1	1
Analysis III (L1030)	Recitation Section (large)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1031)	Lecture	2	2
Differential Equations 1 (Ordinary Differential Equations) (L1032)	Recitation Section (small)	1	1
Differential Equations 1 (Ordinary Differential Equations) (L1033)	Recitation Section (large)	1	1

Module Responsible	Prof. Marko Lindner
Admission Requirements	None
Recommended Previous Knowledge	Mathematics I + II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in the area of analysis and differential equations. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 128, Study Time in Lecture 112
Credit points	8
Course achievement	None
Examination	Written exam
Examination duration and scale	60 min (Analysis III) + 60 min (Differential Equations 1)
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Compulsory

Course L1028: Analysis III	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of differential and integrational calculus of several variables • Differential calculus for several variables • Mean value theorems and Taylor's theorem • Maximum and minimum values • Implicit functions • Minimization under equality constraints • Newton's method for multiple variables • Fourier series • Double integrals over general regions • Line and surface integrals • Theorems of Gauß and Stokes
Literature	• http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1029: Analysis III	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1030: Analysis III	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1031: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	Main features of the theory and numerical treatment of ordinary differential equations • Introduction and elementary methods • Exsitence and uniqueness of initial value problems • Linear differential equations • Stability and qualitative behaviour of the solution • Boundary value problems and basic concepts of calculus of variations • Eigenvalue problems • Numerical methods for the integration of initial and boundary value problems • Classification of partial differential equations
Literature	• http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html

Course L1032: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1033: Differential Equations 1 (Ordinary Differential Equations)	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dozenten des Fachbereiches Mathematik der UHH
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0728: Hydromechanics and Hydrology

Courses

Title	Typ	Hrs/wk	CP
Hydrology (L0909)	Lecture	1	1
Hydrology (L0956)	Project-/problem-based Learning	1	2
Hydromechanics (L0615)	Lecture	2	2
Hydromechanics (L0616)	Project-/problem-based Learning	1	1

Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous Knowledge	Mathematics I, II and III Mechanics I und II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to define the basic terms of hydromechanics, hydrology groundwater hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flows and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and of established reservoir / storage models as well as the concepts of the determination of a unit-hydrograph.
Skills	The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Furthermore, they are able to run, explain and document basic hydraulic experiments. Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems. In addition, the basic concepts of field-measurements of hydrological and hydrodynamic values can be described and the students are able to perform, analyze and assess respective measurements.
Personal Competence	
Social Competence	The students are able to work in groups in a goal-orientated, structured manner. They can explain their results sustainably in plenary sessions by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentations for given topics in groups.
Autonomy	Students are capable of organising their individual work flow to contribute to the conduct of experiments and to present discipline-specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of reflecting their study techniques and learning strategy on an individual basis.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** Yes / None / Excercises / Übungsaufgaben Hydrologie Yes / None / Subject theoretical and practical work / Durchführung, Dokumentation und Präsentation zu einem Versuchs Hydromechanik oder Hydraulik in Gruppen Yes / None / Group discussion / Erstellung eine Posters zu einer Thematik aus dem Themengebiet der Hydrologie in Gruppen und Präsentation
Examination	Written exam
Examination duration and scale	150 minutes
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0909: Hydrology	
Typ	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of hydrology and groundwater hydrology: • Hydrological cycle • Data acquisition in hydrology • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values • rainfall-run-off modelling on the basis of a unit hydrograph concept
Literature	Maniak, U. (2017). Hydrologie und Wasserwirtschaft: Eine Einführung für Ingenieure. Springer Vieweg. Skript "Hydrologie und Gewässerkunde"

Course L0956: Hydrology	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	Introduction to basics of Hydrology: • Hydrological cycle • Data acquisition • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps
Literature	Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde

Course L0615: Hydromechanics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe

Content	Fundamentals of Hydromechanics
	• Characteristics of fluids
	• Hydrostatics
	• Kinematics of flows, laminar and turbulent flows
	• Conservation laws
	  ◦ Conservation of mass
	  ◦ Conservation of Energy
	  ◦ Momentum Equation
	• Application of conservation laws to flow conditions

Literature	Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2 Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998. Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996.

Course L0616: Hydromechanics	
Typ	Project-/problem-based Learning
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1289: Logistical systems - Industry 4.0

Courses

Title	Typ	Hrs/wk	CP
Logistics systems - Industry 4.0 (L1753)	Seminar	4	6

Module Responsible	Prof. Jochen Kreutzfeldt
Admission Requirements	None
Recommended Previous Knowledge	Successful completion of the module „Technical Logistics“
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students will acquire the following knowledge: 1. The students are able to understand and explain the concept "Logistical System". 2. The students are able to design a logistic system conceptually. 3. The students can develop and implement the control of a logistic system with python.
Skills	The students will acquire the following skills: 1. The students are able to identify logistical systems, analyze and identify potential for change and improvement. 2. The students know different technical solutions to address problems in logistical systems. 3. The students are capable of deploying technical solutions and ideas from the concept Industry 4.0 to deal with logistical problems.
Personal Competence	
Social Competence	The students will acquire the following social skills: 1. The students are able to develop technical solutions for logistical systems and reflect their contribution within the team. 2. The technical solutions from the group can be jointly documented and presented. 3. Students are able to present their technological solutions to an audience and derived from the critique new ideas and improvements.
Autonomy	The students will acquire the following independent competencies: 1. The students can independently develop technical solutions for logistical problems under supervision. 2. The students are able to evaluate their technical solutions and discuss the pros and cons. 3. The students are able to assess the impact of the concept Industry 4.0 on their own career development.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Lab prototype with documentation (group work)
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1753: Logistics systems - Industry 4.0	
Typ	Seminar
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Jochen Kreutzfeldt
Language	DE
Cycle	WiSe
Content	The lecture gives an introduction to the concept of logistical systems with a special emphasis on the subject of Industry 4.0. Here, the system concept in logistics from a technical point of view is introduced. A logistical system is understood as a combination of transport, storage and change processes between source and sink of goods. This lecture will look at the technical aspect of these processes. Industry is a topic of this lecture. Industry 4.0 is understood as the far-reaching digitization and networking of logistical systems and the connection of logistical objects, processes and systems. The logistics industry expects Industry 4.0 to be a profound change and the realization of large improvement potentials. The lecture provides an in-depth introduction to application cases and business models of Industry 4.0 in logistics from a technical standpoint. A possible framework for Industry 4.0 is presented and several application examples are shown. In the exercises, students learn will learn the exemplary use of different technical solutions and know how, which can be used to improve logistical systems.
Literature	Bauernhansl, Thomas et al. (2014): Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration. Wiesbaden: Springer Vieweg. Hausladen, Iris (2014): IT-gestützte Logistik. Systeme - Prozesse - Anwendungen. 2. Auflage 2014. Wiesbaden: Imprint: Gabler Verlag. Hompel, Michael ten; Büchter, Hubert; Franzke, Ulrich (2008): Identifikationssysteme und Automatisierung. [Intralogistik]. Berlin, Heidelberg: Springer. Kaufmann, Timothy (2015): Geschäftsmodelle in Industrie 4.0 und dem Internet der Dinge. Der Weg vom Anspruch in die Wirklichkeit. Wiesbaden: Springer Fachmedien Wiesbaden. Martin, Heinrich (2014): Transport- und Lagerlogistik. Planung, Struktur, Steuerung und Kosten von Systemen der Intralogistik. 9., Auflage 2014. Wiesbaden: Imprint: Springer Vieweg. Runkler, Thomas A. (2010): Data-Mining. Methoden und Algorithmen intelligenter Datenanalyse. 1. Aufl. Wiesbaden: Vieweg + Teubner (Studium).

Module M0706: Geotechnics I

Courses

Title	Typ	Hrs/wk	CP
Soil Mechanics (L0550)	Lecture	2	2
Soil Mechanics (L0551)	Recitation Section (large)	2	2
Soil Mechanics (L1493)	Recitation Section (small)	2	2

Module Responsible	Prof. Jürgen Grabe
Admission Requirements	None
Recommended Previous Knowledge	Modules : • Mechanics I-II
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, water or structures, consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure.
Skills	After the successful completion of the module the students should be able to describe the mechanical properties and to evaluate them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weight or influence of structures. They are are able to prove the usability (settlements) for shallow foundations.
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	Compulsory: No; Bonus: 20 %; Form: Attestation; Description:
Examination	Written exam
Examination duration and scale	90 minutes
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0550: Soil Mechanics

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	• Structure of the soil • Ground surveying • Compsitition and properties of the soil • Groundwater • One-dimensional compression • Spreading of stresses • Settlement calculation • Consolidation • Shear strength • Earth pressure • Slope failure • Ground failure • Suspension based earth tenches
Literature	• Vorlesungsumdruck, s. ww.tu-harburg.de/gbt • Grabe, J. (2004): Bodenmechanik und Grundbau • Gudehus, G. (1981): Bodenmechanik • Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau • Grundbau-Taschenbuch, Teil 1, aktuelle Auflage

Course L0551: Soil Mechanics	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1493: Soil Mechanics	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0833: Introduction to Control Systems

Courses

Title	Typ	Hrs/wk	CP
Introduction to Control Systems (L0654)	Lecture	2	4
Introduction to Control Systems (L0655)	Recitation Section (small)	2	2

Module Responsible	NN
Admission Requirements	None
Recommended Previous Knowledge	Representation of signals and systems in time and frequency domain, Laplace transform
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems • They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus • They can explain the Nyquist stability criterion and the stability margins derived from it. • They can explain the role of the phase margin in analysis and synthesis of control loops • They can explain the way a PID controller affects a control loop in terms of its frequency response • They can explain issues arising when controllers designed in continuous time domain are implemented digitally
Skills	• Students can transform models of linear dynamic systems from time to frequency domain and vice versa • They can simulate and assess the behavior of systems and control loops • They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules • They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques • They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation • They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks
Personal Competence	
Social Competence	Students can work in small groups to jointly solve technical problems, and experimentally validate their controller designs
Autonomy	Students can obtain information from provided sources (lecture notes, software documentation, experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Data Science: Specialisation II. Application: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Computer Science in Engineering: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0654: Introduction to Control Systems	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	Signals and systems • Linear systems, differential equations and transfer functions • First and second order systems, poles and zeros, impulse and step response • Stability Feedback systems • Principle of feedback, open-loop versus closed-loop control • Reference tracking and disturbance rejection • Types of feedback, PID control • System type and steady-state error, error constants • Internal model principle Root locus techniques • Root locus plots • Root locus design of PID controllers Frequency response techniques • Bode diagram • Minimum and non-minimum phase systems • Nyquist plot, Nyquist stability criterion, phase and gain margin • Loop shaping, lead lag compensation • Frequency response interpretation of PID control Time delay systems • Root locus and frequency response of time delay systems • Smith predictor Digital control • Sampled-data systems, difference equations • Tustin approximation, digital implementation of PID controllers Software tools • Introduction to Matlab, Simulink, Control toolbox • Computer-based exercises throughout the course
Literature	• Werner, H., Lecture Notes „Introduction to Control Systems“ • G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 • K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 • R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010

Course L0655: Introduction to Control Systems	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	NN
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1070: Simulation of Transport and Handling Systems

Courses

Title	Typ	Hrs/wk	CP
Simulation of Transport and Handling Systems (L1352)	Lecture	1	2
Simulation of Transport and Handling Systems (L1818)	Recitation Section (small)	3	4

Module Responsible	Prof. Carlos Jahn
Admission Requirements	None
Recommended Previous Knowledge	Basic knowledge of transport- and handlingtechnology.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can... • Explain the structure and workings of standard external logistics systems. • Outline the benefits of using simulation software subject to the starting situation. • Present different simulation programs and kinds of simulation that are in widespread use and explain their characteristics.
Skills	Students are able to... • Recognize, analyze, and assemble into a model the elementary building blocks of a logistics system. • Map complex external logistics process using the *Plant Simulation*® simulation software. • Draw inferences from the results of the simulation, transfer them to the reality, and deduce action recommendations from them.
Personal Competence	
Social Competence	Students are capable of... • Solving complex tasks in a team and to document assignments accordingly. • Playing different roles in the teamwork and giving each other appropriate feedback in the team. • Presenting the relevant results of their project to specialists and representing them.
Autonomy	Students are able... • To acquaint themselves independently with software with which they are not familiar and to use it to solve complex tasks. • To define work steps independently and to acquire the knowledge required to do so.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	**Compulsory** / **Bonus** / **Form** / **Description** No / 20 % / Subject theoretical and practical work
Examination	Subject theoretical and practical work
Examination duration and scale	Simulation study and report with approximately 15 pages per person
Assignment for the Following Curricula	Data Science: Core Qualification: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1352: Simulation of Transport and Handling Systems	
Typ	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	The lecture deals with the simulation of external logistics systems. The focus is therefore on the consideration of logistical processes between companies or on transhipment systems, such as ports or individual terminals. In the first part of the lecture, students will first acquire basic knowledge of external logistics systems and the advantages of using simulations to present them. Then an overview of existing simulation types and programs is given and examples for existing simulation models of logistic systems in science and practice are shown. Some simulation models will be demonstrated. In the second part of the lecture the students learn the basic handling of the simulation software Plant Simulation®. They receive theoretical explanations of the general functionality of the simulation tool, which are further deepened through the use of extensive, interactive examples. At the same time, five exercises, which build on each other, offer students the opportunity to implement the course content they have learnt alone and in small groups. The exercises can be completed during the supervised lecture periods as well as at other times. The acquired knowledge is to be applied in the third part in the course of group work. The students will be divided into groups, each of which will then work on a relevant problem from the field of (external) logistic systems by means of simulation. The students are given a defined period of time for their work. During this time at least one person is always available for questions and suggestions. The results of the group work are to be documented in a simulation report and handed in at the end of the processing time. Finally, the individual groups present the problems they have worked on and their results in a presentation.
Literature	Bangsow, Steffen (2011): Praxishandbuch Plant Simulation und SimTalk. Anwendung und Programmierung in über 150 Beispiel-Modellen. München: Hanser Verlag. Eley, Michael (2012): Simulation in der Logistik. Einführung in die Erstellung ereignisdiskreter Modelle unter Verwendung des Werkzeuges "Plant Simulation". Berlin, Heidelberg: Springer. Engelhardt-Nowitzki, Corinna; Nowitzki, Olaf; Krenn, Barbara (2008): Management komplexer Materialflüsse mittels Simulation. State-of-the-Art und innovative Konzepte. Wiesbaden: Deutscher Universitäts-Verlag / GWV Fachverlage GmbH, Wiesbaden. Rabe, Markus; Spieckermann, Sven; Wenzel, Sigrid (2008): Verifikation und Validierung für die Simulation in Produktion und Logistik. Vorgehensmodelle und Techniken. Berlin, Heidelberg: Springer. Sargent, Robert G. (2010): Verification and Validation of Simulation Models. In: B. Johansson, S. Jain, J. Montoya-Torres, J. Hugan, and E. Yücesan, eds.: Proceedings of the 2010 Winter Simulation Conference. VDI-Richlinie: VDI 3633. Simulation von Logistik-, Materialfluß-und Produktionssystemen Wenzel, Sigrid; Rabe, Markus; Spieckermann, Sven (2006): Verifikation und Validierung für die Simulation in Produktion und Logistik. Vorgehensmodelle und Techniken. 1. Aufl. Berlin: Springer Berlin.

Course L1818: Simulation of Transport and Handling Systems	
Typ	Recitation Section (small)
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0852: Graph Theory and Optimization

Courses

Title	Typ	Hrs/wk	CP
Graph Theory and Optimization (L1046)	Lecture	2	3
Graph Theory and Optimization (L1047)	Recitation Section (small)	2	3

Module Responsible	Prof. Anusch Taraz
Admission Requirements	None
Recommended Previous Knowledge	• Discrete Algebraic Structures • Mathematics I
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• Students can name the basic concepts in Graph Theory and Optimization. They are able to explain them using appropriate examples. • Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. • They know proof strategies and can reproduce them.
Skills	• Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. • Students are able to discover and verify further logical connections between the concepts studied in the course. • For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results.
Personal Competence	
Social Competence	• Students are able to work together in teams. They are capable to use mathematics as a common language. • In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers.
Autonomy	• Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. • Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	120 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Data Science: Elective Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Engineering Science: Specialisation Data Science: Elective Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L1046: Graph Theory and Optimization	
Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/EN
Cycle	SoSe
Content	• Graphs, search algorithms for graphs, trees • planar graphs • shortest paths • minimum spanning trees • maximum flow and minimum cut • theorems of Menger, König-Egervary, Hall • NP-complete problems • backtracking and heuristics • linear programming • duality • integer linear programming
Literature	• M. Aigner: Diskrete Mathematik, Vieweg, 2004 • T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Algorithmen - Eine Einführung, Oldenbourg, 2013 • J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007 • A. Steger: Diskrete Strukturen (Band 1), Springer, 2001 • A. Taraz: Diskrete Mathematik, Birkhäuser, 2012 • V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009 • K.-H. Zimmermann: Diskrete Mathematik, BoD, 2006

Course L1047: Graph Theory and Optimization	
Typ	Recitation Section (small)
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Anusch Taraz
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0536: Fundamentals of Fluid Mechanics

Courses

Title	Typ	Hrs/wk	CP
Fundamentals of Fluid Mechanics (L0091)	Lecture	2	2
Fundamentals on Fluid Mechanics (L2933)	Recitation Section (small)	2	2
Fluid Mechanics for Process Engineering (L0092)	Recitation Section (large)	2	2

Module Responsible: Prof. Michael Schlüter

Admission Requirements: None

Recommended Previous Knowledge

- Mathematics I+II+III
- Technical Mechanics I+II
- Technical Thermodynamics I+II
- Working with force balances
- Simplification and solving of partial differential equations
- Integration

Educational Objectives: After taking part successfully, students have reached the following learning results

Professional Competence

Knowledge: Students are able to:

- explain the difference between different types of flow
- give an overview for different applications of the Reynolds Transport-Theorem in process engineering
- explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions

Skills: The students are able to

- describe and model incompressible flows mathematically
- reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration
- notice the dependency between theory and technical applications
- use the learned basics for fluid dynamical applications in fields of process engineering

Personal Competence

Social Competence: The students

- are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and
- able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises)
- are able to work out solutions for exercises by themselves, to discuss the solutions orally and to present the results.

Autonomy: The students are able to

- search further literature for each topic and to expand their knowledge with this literature,
- work on their exercises by their own and to evaluate their actual knowledge with the feedback.

Workload in Hours: Independent Study Time 96, Study Time in Lecture 84

Credit points: 6

Course achievement

Compulsory	Bonus	Form	Description
No	5 %	Midterm	

Examination: Written exam

Examination duration and scale: 3 hours

Assignment for the Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Green Technologies: Compulsory
General Engineering Science (German program, 7 semester): Specialisation Chemical and Bioengineering: Compulsory
Bioprocess Engineering: Core Qualification: Compulsory
Chemical and Bioprocess Engineering: Core Qualification: Compulsory
Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory
Integrated Building Technology: Core Qualification: Compulsory
Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Process Engineering: Core Qualification: Compulsory
Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0091: Fundamentals of Fluid Mechanics	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	• fluid properties • hydrostatic • overall balances - theory of streamline • overall balances- conservation equations • differential balances - Navier Stokes equations • irrotational flows - Potenzialströmungen • flow around bodies - theory of physical similarity • turbulent flows • compressible flows
Literature	1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. 2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. 3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. 12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Course L2933: Fundamentals on Fluid Mechanics	
Typ	Recitation Section (small)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the group exercise, the contents of the lecture are taken up and deepened by means of exercises. The exercise tasks correspond in quality and scope to the tasks of the written exam. Topics: Reynolds transport-theorem, pipe flow, free jet, angular momentum, Navier-Stokes equations, potential theory, mock exam, pipe hydraulics, pump design.
Literature	Heinz Herwig: Strömungsmechanik, Eine Einführung in die Physik und die mathematische Modellierung von Strömungen, Springer Verlag, Berlin, 978-3-540-32441-6 (ISBN) Herbert Oertel, Martin Böhle, Thomas Reviol: Strömungsmechanik für Ingenieure und Naturwissenschaftler, Springer Verlag, Berlin, ISBN: 978-3-658-07786-0 Joseph Spurk, Nuri Aksel: Strömungslehre, Einführung in die Theorie der Strömungen, Springer Verlag, Berlin, ISBN: 978-3-642-13143-1.

Course L0092: Fluid Mechanics for Process Engineering	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Michael Schlüter
Language	DE
Cycle	SoSe
Content	In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards.
Literature	1. Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. 2. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. 3. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994 4. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006 5. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 6. Kuhlmann, H.C.: Strömungsmechanik. München, Pearson Studium, 2007 7. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009 8. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007 9. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008 10. Schlichting, H. : Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006 11. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. 12. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011

Module M0767: Aeronautical Systems

Courses

Title	Typ	Hrs/wk	CP
Fundamentals of Aircraft Systems (L0741)	Lecture	2	2
Fundamentals of Aircraft Systems (L0742)	Recitation Section (small)	1	1
Air Transportation Systems (L0591)	Lecture	2	2
Air Transportation Systems (L0816)	Recitation Section (large)	1	1

Module Responsible	Prof. Frank Thielecke
Admission Requirements	None
Recommended Previous Knowledge	Basics of mathematics, mechanics and thermodynamics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired.
Skills	Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the context of the overall system.
Personal Competence	
Social Competence	Students are made aware of interdisciplinary communication in groups.
Autonomy	Students are able to independently analyze different system concepts and their technical implementation as well as to think system oriented.
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	150 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory Data Science: Specialisation II. Application: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0741: Fundamentals of Aircraft Systems

Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	• Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials • Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems
Literature	• Shevell, R. S.: Fundamentals of Flight • TÜV Rheinland: Luftfahrtzeugtechnik in Theorie und Praxis • Wild: Transport Category Aircraft Systems

Course L0742: Fundamentals of Aircraft Systems

Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Thielecke
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0591: Air Transportation Systems	
Typ	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	SoSe
Content	1. Air transport as part of the global transportation system 2. Legal basis of air transportation 3. Safety and security aspects 4. Aircraft basics 5. The role of the aircraft amnufacturer 6. The role of the aircraft operator 7. Airport operation 8. The principles of air traffic management 9. Environmental aspects of air transportation
Literature	1. V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 2. H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 3. J.P. Clark: “Buying the Big Jets”, ISBN 9781317170341 , Taylor & Francis, 2017 4. Mike Hirst: The Air Transport System, AIAA, 2008 5. D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 6. N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN 0-07-003077-4 7. P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8 8. H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0

Course L0816: Air Transportation Systems	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Volker Gollnick
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1633: Planning Law and Environmental Law/ Sustainable Urban Development

Courses

Title	Typ	Hrs/wk	CP
Sustainable Urban Development (L2474)	Lecture	2	3
Planning law and Environmental law (L2473)	Lecture	2	3

Module Responsible	Prof. Ralf Otterpohl
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	
Skills	
Personal Competence	
Social Competence	
Autonomy	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Written-theoretical part and report
Assignment for the Following Curricula	Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L2474: Sustainable Urban Development

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Irene Peters
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2473: Planning law and Environmental law

Typ	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Martin Wickel
Language	DE
Cycle	SoSe
Content	
Literature	

Module M1014: Logistics Service Provider Management

Courses

Title	Typ	Hrs/wk	CP
Logistics Service Provider Management (L1240)	Seminar	3	6

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	• Introduction to Logistics and Mobility • Transport and cross-docking Technology • Logistics Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • integrate LSPs into the concept of business logistics • tell the specifics of business services and logistics Services and their derived characteristics • describe logistics functions as LSP service packages • explain, why companies outsource logistics Services and what are actual trends in Business • describe basic outsorucing processes and tender management success factors • describe and analyze intra- and intermodal transport institutions as well as tasks, challenges and opportunities for the Management of LSPs
Skills	Students can... • support the sub-segment specific business functions and management Tasks (e.g. for Road Transport, Airlines, SeaPort Providers etc.) • categorize LSPs regarding strategic product-market-positioning • derive action plans regarding management tasks depending on contigencies
Personal Competence	
Social Competence	Students can... • discuss case studies in Groups (within and outside of the classroom), reaching a common understanding and result • prepare and deliver Business presentations • give and discuss Feedbacks in the large group
Autonomy	Students can... • produce written reports independently
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	2 scientific written papers of approx. 20 pages each. Presentation (approx. 15 pages) with 20-minute closing lecture in groups of 3 to max. 5 persons. Grading of 4 partial grades of 25% each (2 seminar papers, 2 presentation documents) individually per group member.
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L1240: Logistics Service Provider Management	
Typ	Seminar
Hrs/wk	3
CP	6
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Lecturer	Prof. Stephan Freichel
Language	DE
Cycle	SoSe
Content	**1 Concept and Functions** Define the role of logistics services providers in the overall concept and functions of logistics services providers. Workshop on the role of logistics services providers in the economy, based on up-to-date topics in the field and in the news. **2 Outsourcing and Cooperation** Make or buy, forms and management of inter-organizational relations **3 Institutions** Special business management features of carriers, haulage contractors, CEP services **4 Trends, Strategies and Management Functions** Market trends, requirements, basic business management and management functions (operations, business development, HR, IT, finance/planning and control, organization, leadership) **5 Strategic Developments and Case Studies** Selected aspects (e.g. risk and innovation management, global and regional networking, greenwashing and sustainability) Examples: Case Study A) Types of company (such as haulage contractors, railway operators, road transport companies, heavy goods, textile and refrigerated goods specialists, CEPs, etc) will be introduced and discussed in the context of a presentation. Case Study B) Individual companies will be analyzed on the basis of accessible material such as company reports, websites and possibly telephone interviews and case studies will be explained and discussed with regard to the functions of the logistics services provider and the management task of the corporate managements of the selected cases.
Literature	Pfohl, H.-Chr.: Logistiksysteme. Betriebswirtschaftliche Grundlagen. 8., neu bearbeite und aktualisierte Auflage, Berlin u.a. 2009 Eßig, M. / Hofmann, E. / Stölzle, W.: Supply Chain Management. München 2013. Freichel, S.L.K.: Organisation von Logistikservice-Netzwerken. Reihe: Logistik und Unternehmensführung, hrsg. von Prof. Dr. H.-Chr. Pfohl, Bd. 4. Berlin 1993. Aberle, G.: Transportwirtschaft. Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen, 4. überarbeitete und erweiterte Auflage, München/Wien 2006. Buchholz, J./Clausen, U./Vastag, A. (Hrsg): Handbuch der Verkehrslogistik, Heidelberg 1998. Corsten, H.: Dienstleistungsmanagement, 3. Auflage, München 1997. Müller-Daupert, B. (Hrsg.): Logistik-Outsourcing, 2. Auflage, München, Vogel, 2009 Ihde, G. B.: Transport, Verkehr, Logistik. Gesamtwirtschaftliche Aspekte und einzelwirtschaftliche Handhabung, 3. völlig überarb. und erw. Auflage, München 2001. van Suntum, U.: Verkehrspolitik, München 1986.

Module M0610: Electrical Machines and Actuators

Courses

Title	Typ	Hrs/wk	CP
Electrical Machines and Actuators (L0293)	Lecture	3	4
Electrical Machines and Actuators (L0294)	Recitation Section (large)	2	2

Module Responsible	Prof. Thorsten Kern
Admission Requirements	None
Recommended Previous Knowledge	Basics of mathematics, in particular complexe numbers, integrals, differentials Basics of electrical engineering and mechanical engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can to draw and explain the basic principles of electric and magnetic fields. They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the driven engine.
Skills	Students are able to calculate two-dimensional electric and magnetic fields in particular ferromagnetic circuits with air gap. For this they apply the usual methods of the design auf electric machines. They can calulate the operational performance of electric machines from their given characteristic data and selected quantities and characteristic curves. They apply the usual equivalent circuits and graphical methods.
Personal Competence	
Social Competence	none
Autonomy	Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse independently the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantities and characteristic curves.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70
Credit points	6
Course achievement	None
Examination	Subject theoretical and practical work
Examination duration and scale	Design of four machines and actuators, review of design files
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Elective Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compulsory Engineering Science: Specialisation Electrical Engineering: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Energy Technology: Elective Compulsory Green Technologies: Energy, Water, Climate: Specialisation Maritime Technologies: Elective Compulsory Computer Science in Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Mechanical Engineering: Core Qualification: Elective Compulsory Mechatronics: Specialisation Naval Engineering: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Specialisation Robot- and Machine-Systems: Compulsory Mechatronics: Specialisation Electrical Systems: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory

Course L0293: Electrical Machines and Actuators	
Typ	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation, Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands´diagram), torque vs. speed characteristics, rotor layout (squirrel-cage vs. sliprings), Drives with variable speed, inverter fed operation, special drives
Literature	Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen"

Course L0294: Electrical Machines and Actuators	
Typ	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Thorsten Kern, Dennis Kähler
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0985: Introduction to Railways

Courses

Title	Typ	Hrs/wk	CP
Introduction to Railways (L1184)	Lecture	2	4
Introduction to Railways (L1185)	Recitation Section (large)	1	2

Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous Knowledge	none
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students can... • give definitions for basic terms related to railways • explain specifics concerning the handling of goods on railways • explain the required infrastructure • describe the work at the track super structure
Skills	--
Personal Competence	
Social Competence	Students can... • work at tasks in groups and come to results together • discuss contents in groups, summarize them and present them in front of others • convey contents to other by processing them in writing
Autonomy	Students can work out and understand contents themselves during the lecture through literature research
Workload in Hours	Independent Study Time 138, Study Time in Lecture 42
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	Civil- and Environmental Engineering: Specialisation Traffic and Mobility: Compulsory Civil- and Environmental Engineering: Specialisation Civil Engineering: Elective Compulsory Civil- and Environmental Engineering: Specialisation Water and Environment: Elective Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L1184: Introduction to Railways

Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	André Schoppe
Language	DE
Cycle	SoSe
Content	Lecture: The module provides a basic knowledge of the field of railroad engineering. An overview of railroad operations, control and safety technology, railroad superstructure, structural engineering, project management as well as maintenance and design of infrastructure facilities is given. The aim of this module is to give students as much insight as possible into railroad infrastructure. The module is examined by means of a written exam at the end of the semester. Lecture Hall Exercise: In order to give the students practical examples, full-day practical excursions are carried out. New handling techniques and currently available hardware will be presented by visiting the marshalling yard "die Zugbildungsanlage Maschen (ZBA)". Furthermore, the training center for track construction and civil engineering as well as the operations center in Hanover will be visited, where facilities and tasks will be presented. Questionnaires will also be provided for practice purposes. In addition, study papers can be handed out and supervised as required.
Literature	Die maßgebliche Literatur wird in StudIP veröffentlicht. Weitere Hinweise werden in der Veranstaltung gegeben.

Course L1185: Introduction to Railways	
Typ	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	André Schoppe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0980: Logistics, Transport and Environment

Courses

Title	Typ	Hrs/wk	CP
Logistics, Transport and Environment (L0009)	Project-/problem-based Learning	2	4
Environmental Management and Corporate Responsibilty (L1160)	Seminar	2	2

Module Responsible	Prof. Heike Flämig
Admission Requirements	None
Recommended Previous Knowledge	• Introduction to logistics and mobility • Foundations of Management
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to... • explain basic terms of transport logistics, commercial traffic, transport policy and sustainability • describe actors and system boundaries, challenges and goals of transport logistics • reflect standards of sustainability management
Skills	Students are able to... • design logistics systems independently • differentiate sustainability, CR, CSR and environmental management • critically evaluate measures for sustainable logistics and develop them
Personal Competence	
Social Competence	Students can... • creatively develop solutions in teams and work out presentations • present their knowledge and skills to other students
Autonomy	Students can... • carry out small research studies independently • apply theoretical knowledge in practical projects • apply presentation techniques such as free speech, designing charts (i.e. in Power-Point), use of media (Flip-Charts, Whiteboard, Metaplan)
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	Written assignment with short presentation
Assignment for the Following Curricula	Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Logistics and Mobility: Specialisation Information Technology: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory

Course L0009: Logistics, Transport and Environment	
Typ	Project-/problem-based Learning
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	Application and creative development of professional knowledge within the framework of the case study "Environmental impacts of supply chains" using a specific company as example. Depending on the chosen focus of the academic year: • characteristics of different transport systems • technologies, structures and processes of transport logistics systems (nodes, network, interactions) • location and route planning • connections of information flow and material flows in transport chains • interrelation between private and private (contract logistics) and private and public (business policy, transport policy) and their (diverging) • design approaches for sustainable logistics
Literature	Ihde, Gösta B.: Transport, Verkehr, Logistik. Gesamtwirtschaftliche Aspekte und einzelwirtschaftliche Handhabung. 3. überarbeitete Auflage. Vahlen, München 2001

Course L1160: Environmental Management and Corporate Responsibilty	
Typ	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	• Imparting knowledge about standards (e.g. EMAS and ISO 14.001) as important methodological approaches for the integration of environmental and sustainability management in business companies • Explaination of theoretical concepts of corporate sustainability management • Imparting pracitical knowledge from different stakeholder views: consulting company, trading enterprise, NGO, financial market
Literature	--

Module M0671: Technical Thermodynamics I

Courses

Title	Typ	Hrs/wk	CP
Technical Thermodynamics I (L0437)	Lecture	2	4
Technical Thermodynamics I (L0439)	Recitation Section (large)	1	1
Technical Thermodynamics I (L0441)	Recitation Section (small)	1	1

Module Responsible	Prof. Arne Speerforck
Admission Requirements	None
Recommended Previous Knowledge	Elementary knowledge in Mathematics and Mechanics
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are familiar with the laws of Thermodynamics. They know the relation of the kinds of energy according to 1 st law of Thermodynamics and are aware about the limits of energy conversions according to 2nd law of Thermodynamics. They are able to distinguish between state variables and process variables and know the meaning of different state variables like temperature, enthalpy, entropy and also the meaning of exergy and anergy. They are able to draw the Carnot cycle in a Thermodynamics related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equations of state. They know the meaning of a fundamental state of equation and know the basics of two phase Thermodynamics.
Skills	Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and heat for simple change of states and to use this calculations for the Carnot cycle. They are able to calculate state variables for an ideal and for a real gas from measured thermal state variables.
Personal Competence	
Social Competence	The students can discuss in small groups and work out a solution. You can answer comprehension questions about the content that are provided in the lecture with the ClickerOnline tool "TurningPoint" after discussions with other students.
Autonomy	Students can understand the problems posed in tasks physically. They are able to select the methods taught in the lecture and exercise to solve problems and apply them independently to different types of tasks.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written exam
Examination duration and scale	90 min
Assignment for the Following Curricula	General Engineering Science (German program, 7 semester): Core Qualification: Compulsory Bioprocess Engineering: Core Qualification: Compulsory Chemical and Bioprocess Engineering: Core Qualification: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Engineering Science: Specialisation Mechanical Engineering: Compulsory Engineering Science: Specialisation Mechatronics: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory Engineering Science: Specialisation Advanced Materials: Elective Compulsory Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory Integrated Building Technology: Core Qualification: Compulsory Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Mechatronics: Core Qualification: Elective Compulsory Orientation Studies: Core Qualification: Elective Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core Qualification: Compulsory Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory

Course L0437: Technical Thermodynamics I	
Typ	Lecture
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	SoSe
Content	1. Introduction 2. Fundamental terms 3. Thermal Equilibrium and temperature 3.1 Thermal equation of state 4. First law 4.1 Heat and work 4.2 First law for closed systems 4.3 First law for open systems 4.4 Examples 5. Equations of state and changes of state 5.1 Changes of state 5.2 Cycle processes 6. Second law 6.1 Carnot process 6.2 Entropy 6.3 Examples 6.4 Exergy 7. Thermodynamic properties of pure fluids 7.1 Fundamental equations of Thermodynamics 7.2 Thermodynamic potentials 7.3 Calorific state variables for arbritary fluids 7.4 state equations (van der Waals u.a.)
Literature	• Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009 • Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012 • Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993

Course L0439: Technical Thermodynamics I	
Typ	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0441: Technical Thermodynamics I	
Typ	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Arne Speerforck
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Thesis

Module M-001: Bachelor Thesis

Courses

Title	Typ	Hrs/wk	CP

Module Responsible	Professoren der TUHH
Admission Requirements	• According to General Regulations §21 (1): At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	• The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods). • On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise. • The students are able to outline the state of research on a selected issue in their subject area.
Skills	• The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems. • With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions. • The students can take up a critical position on the findings of their own research work from a specialized perspective.
Personal Competence	
Social Competence	• Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way. • The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they can uphold their own assessments and viewpoints convincingly.
Autonomy	• The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame. • The students are able to identify, open up, and connect knowledge and material necessary for working on a scientific problem. • The students can apply the essential techniques of scientific work to research of their own.
Workload in Hours	Independent Study Time 360, Study Time in Lecture 0
Credit points	12
Course achievement	None
Examination	Thesis
Examination duration and scale	According to General Regulations
Assignment for the Following Curricula	General Engineering Science (German program): Thesis: Compulsory General Engineering Science (German program, 7 semester): Thesis: Compulsory Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Data Science: Thesis: Compulsory Digital Mechanical Engineering: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Engineering Science: Thesis: Compulsory General Engineering Science (English program): Thesis: Compulsory General Engineering Science (English program, 7 semester): Thesis: Compulsory Green Technologies: Energy, Water, Climate: Thesis: Compulsory Computer Science in Engineering: Thesis: Compulsory Integrated Building Technology: Thesis: Compulsory Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechatronics: Thesis: Compulsory Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory Process Engineering: Thesis: Compulsory Engineering and Management - Major in Logistics and Mobility: Thesis: Compulsory