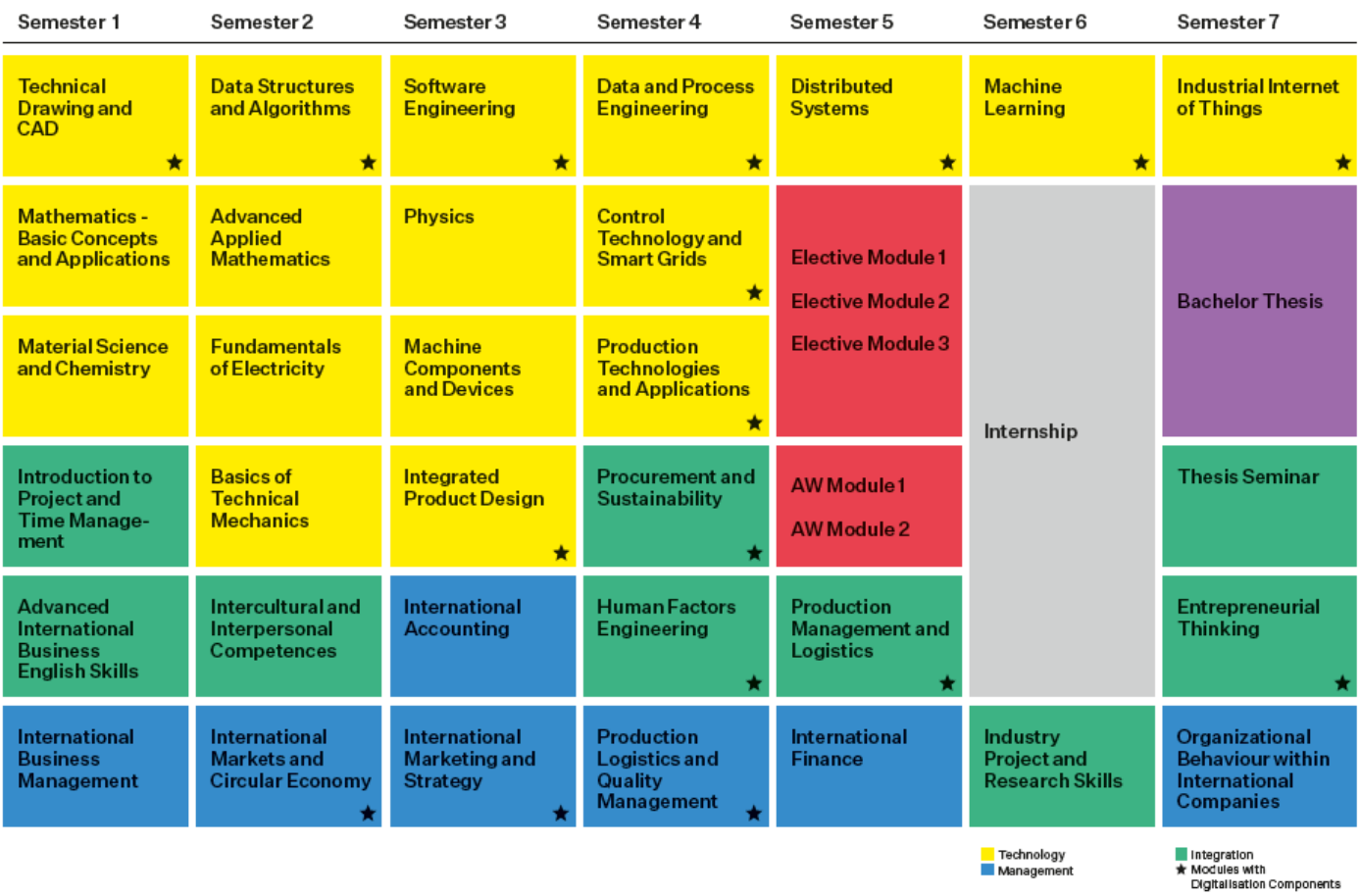
Bachelor‘s Degree Programme
International Management an Digital Engineering
at Munich University of Applied Sciences

Valid for: WS 24/25

Curriculum

Bachelor
International Management and Digital Engineering (IMADE)



1 Study Programme

Bachelor's Degree Programme International Management and Digital Engineering

Curriculum 1st and 2nd Semester

	1. Sem		2. Sem	
	SWS	**ECTS**	**SWS**	**ECTS**
Technology				
Technical Drawing and CAD	4	5		
Mathematics – Basic	6	5		
Material Science and Chemistry	4	5		
Data Structures and Algorithms			4	5
Advanced Applied Mathematics			4	5
Fundamentals of Electricity			4	5
Basics of Technical Mechanics			4	5
Integration				
Advanced International Business English Skills	4	5		
Intercultural and Interpersonal Competences			4	5
Introduction to Project and Time Management	4	5		
Management				
International Business Management	4	5		
International Markets and Circular Economy			4	5
Total	**26**	**30**	**24**	**30**

SWS Semester hours per week
ECTS Credit Points

Curriculum 3rd to 7th semester

	3. Sem		4. Sem		5. Sem		6. Sem		7. Sem	
	SWS	**ECTS**	**SWS**	**ECTS**	**SWS**	**ECTS**	**SWS**	**ECTS**	**SWS**	**ECTS**
Technology										
Control Technology and Smart Grids			4	5						
Data and Process Engineering			4	5						
Distributed Systems					4	5				
Industrial Internet of Things									4	5
Integrated Product Design	4	5								
Machine Components	4	5								
Machine Learning							4	5		
Production Technologies and Applications			4	5						
Physics	4	5								
Software-Engineering	4	5								
Management										
International Accounting	4	5								
International Finance					4	5				
International Marketing and Strategy	4	5								
Organizational Behaviour with-ing International Companies									4	5
Production Logistics and Quality Management			4	5						
Production Management and Logistics					4	5				
Integration										
Human Factors Engineering			4	5						
Entrepreneurial Thinking									4	5
Industry Project and Research Skills							4	5		
Procurement and Sustainabilty			4	5						
Thesis Seminar									2	2
Elective Module					3-4	4				
Elective Module					3-4	4				
Elective Module					3-4	4				
General Studies					2	2				
General Studies					2	2				
Internship (In addition, 10 ECTS courses must be completed during the practical semester. These courses are already included in the above-mentioned range of subjects).								20		

Bachelor Thesis										12
Total	**24**	**30**	**24**	**30**	**25 - 28**	**31**	**8**	**30**	**14**	**29**

2 Elective Modules

All elective modules have a scope of 3 or 4 teaching hours per week and 4 ECTS and are offered as seminar-style teaching.

Overview of possible elective modules that are offered at regular intervals:

Modulbezeichnung	Module title	Examination Duration	Frequency[2]
3D-Druck & - Design	3D printing & design	Module work	Every semester
[1)]	Aerodynamic Principles for Automotive Design	Written Exam, 90 + module work	Summer semester
[1)]	Change Management	Module work	Every semester
[1)]	Cost Management at the Interface of Engineering and Business	Written Exam, 90	Winter semester
[1)]	Digital Marketing Basics	Module work	Every semester
[1)]	Seminar on Renewable Energy for a Sustainable Future	Module work	Every semester
Entwicklung und Konstruktion mit CAD	Development and construction with CAD	Module work	Every semester
Entwicklung einer Geschäftsidee	Developing of a Business Idea	Module work	Every semester
Fachsprache B (französisch/spanisch)		Written exam 60+Pr 10	Every semester
Ganzheitliche Produktentwicklung am Beispiel der Auto-mobilindustrie	Holistic product development using the automotive industry as an example	Module work	Every semester
Kfz.-Schäden u. –bewertungen	Automotive accident damages and appraisal	Written Exam, 90	Winter semester
Kontraktlogistik und e-Fulfillment	Contract logistics and E-Fulfillment	Module work	Every semester
Industrie 4.0 Praktikum	Industry 4.0	Pr	Every semester
Integrierte Geschäftsprozesse mit SAP ERP	Integrated Business Processes with SAP ERP	Written Exam, 90	Every semester
Lieferantenmanagement	Supplier Management	Pr	Every semester
Methoden der Produktentwicklung aktiv anwenden	Applying Product Development Methods actively	ModW + Ref	Every semester
Öffentliche Beschaffung und Logistik	Public Sourcing and Logistics	Module work	Winter semester
Produktergonomie	Ergonomic Product Design	Written Exam, 90	Every semester

Produktivitätsmanagement	Methods Time Measurement	Written Exam, 90	Summer semester
Projektmanagement in der Praxis I	Project Management in Practice I	Module work	Every semester
Projektmanagement in der Praxis II	Project Management in Practice II	Module work	Every semester
Unfallmechanik	Mechanics of Car Accidents	Written Exam, 90	Winter semester
Verhandlungsführung	Conduct of negotiations	Module work	Every semester
Warehouse Management Praktikum	Warehouse Management Lab	ModA+ Ref	Summer semester
ZukunftGestalten@HM		Module work	Summer semester

1) This module is taught in English.
2) The catalog of compulsory elective modules is decided a new each semester by the Faculty Council. This is therefore a non-binding assessment.

Legend:

ModW	Module work	Ref	Referat
wrE	written exam	orE	oral exam
Pr	Presentation	praE	pracital Exam

3 Module description

3.1 Mandatory Modules Semester 1

Module title:	ADVANCED INTERNATIONAL BUSINESS ENGLISH SKILLS
Module coordinator:	Prof. Dr. Rowanne Sayer
Lecturer(s):	Prof. Dr. Rowanne Sayer Further lecturers
Language of instruction of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.)
Teaching method: Hours per week (SWS):	Seminars/self-study/revision 4 SWS
Study workload:	Attendance time: 60 hours Self-study/revision/exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Language of instruction proficiency of B2 in Business English(cf. Common European Framework of Reference, CEFR)
Overview & applicability:	This module provides advanced IBE communication skills for industrial engineers and ensures that students reach the CEFR level of C1/C1+ in all aspects of international BE.
Learning objectives/competencies:	On successful completion of this course, all students will have further developed and mastered: • All key aspects of international business English using all four Language of instruction skills: reading, writing, listening and speaking • The vocabulary, theory and application of a range of topics which are relevant to their course of studies and professional development. • Essential BE communication skills, in particular presentational skills, meetings, reports, etc. • A series of relevant grammar topics at the highest level of BE proficiency: C1/C1+
Course content:	This course focuses on various areas of professional interest to students of engineering, business and economics entering the global, diverse workplace, including: energy, sustainability, automation, globalization, finance, corporate cultures and responsibility, business ethics. While the course covers all the main aspects of IBE communication skills, particular attention is given to fine-tuning students' speaking leadership toolkit (presentations, meetings, teleconferencing) and advanced writing skills (all business correspondence, minutes, reports and chart analysis).

Assessment method:	Module work (ModA) Students need to generate several documents reflecting different parts of the lecture.
Literature/ recommended reading:	*Advanced Market Leader: Business English Course Book.* Authors: Iwonna Dubicka, Margaret O'Keeffe; Pearson Education Ltd 2016 (available in the main library) Supplemented by a range of relevant materials and media.

Module title:	INTERNATIONAL BUSINESS MANAGEMENT
Module coordinator:	Prof. Dr. rer. pol. Verena McIntosh
Lecturer(s):	Prof. Dr. Andreas Englbrecht Prof. Dr. Mathias Gabrysch Prof. Dr. rer. pol. Verena McIntosh
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 1st Semester
Teaching method: Hours per week (SWS):	Seminar-like lecture, exercises and case studies 4 teaching per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	none
Overview & applicability:	The module is fundamental for the further modules with economic content.
Course objectives:	Competency level 2 "Understand": Students are able to understand relevant relations between companies and their stakeholders Competence level 3 "Apply": Students are able to apply instruments of coordination and management. Competence Level 4 "Analyse": Students are able to identify and differentiate key value-added proesses and operational functions. Competency Level 5 "Evaluate": Students are able to evaluate the importance of constitutive decisions of the management. Competency Level 6 "Design": Students are able to develop concepts for the interaction of the essential value creation processes and operational functions.
Course content:	Introduction to the fundamental concepts of Business Administration (BWL) and their application in the engineering industry: • Management principles, including planning, organizing, leading, and controlling • Key figures (productivity, profitability, liquidity)

	• Operations management and supply chain management • Finance, accounting and cost management • Marketing concepts, including market analysis, product development, and branding. • International business and globalization The module provides a real life business case. The students work in teams and take decisions on their own and as a team. Details will be provided in the lectures.
Assessment method:	Written exam Duration: 90 minutes
Literature/ recommended reading:	HILL, Charles W. and Steven L. McShane, 2008, *Principles of Management*, Boston, McGraw-Hill. ISBN 978-0-071-10098-4. EBERT, Ronald et al, 2022, *Business Essentials*, 13th edition, Pearson. ISBN 978-1-292-42702-7

Module title	INTRODUCTION TO TIME AND PROJECT MANAGEMENT (TPM)
Module coordinator:	Prof. Dr.-Ing. Bernd Schulz
Lecturer(s):	Prof. Dr.-Ing. Jörg Elias Prof. Dr.-Ing. Christiane Fritze Prof. Dr.-Ing. Stefan Raber Prof. Dr.-Ing. Bernd Schulz Prof. Dr.-Ing. Jürgen Spitznagel
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 1st semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 SWS
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 60 hours
ECTS:	5 ECTS
Prerequisites:	none
Overview & applicability:	This module gives a general overview of how to handle and steer projects
Learning objectives / competencies:	Competence level 2 “Understanding”: • Students are able to describe the basic interrelationships in project management. • Students are able to assign essential terms, procedures and methods for project development to: preparation, planning, commissioning, monitoring and controlling. • Students understand distractors and how to mitigate these. • Students understand the relevance of prioritization for time management. • Students understand the concept of OKR and how this relates to project management and time management. Competence level 3 “Apply”: Students can apply weekly and daily planning to their own workload. Competence level 4 “Analyse”: Students can analyse typical project situations and identify suitable solutions and measures.
Course content:	• Basic principles of project management • Objectives and project assignment • Procedure models in project management • Project structuring • Methodology for scheduling and cost planning • Project controlling • Project organization and project team leadership • Distractors and how to manage these

	• Eisenhower Matrix, Pareto Principle • Weekly and daily planning derived from broader objectives • OKRs
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading:	KUSTER J.; et al. 2023, *Project Management Handbook*, 2. Auflage. Springer Verlag. ISBN 978-3-662-66211-3 (e-book), ISBN 978-3-662-66213-7 (soft cover) STEMMLE, D. 2019, *Time Management Secrets for College Students: The Underground Playbook for Managing School*, Work, and Fun (College Success). : College Success Academy Press, ISBN-10 : 069219746X, ISBN-13 : 978-0692197462

Module title:	MATERIAL SCIENCE AND CHEMISTRY
Module coordinator:	Prof. Dr. Stefan Raber Prof. Dr. Karlheinz Trebesius
Lecturer(s):	Prof. Dr. Stefan Raber Prof. Dr. Karlheinz Trebesius Prof. Dr. Christiane Fritze External lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 1st semester
Teaching method: Hours per week (SWS):	Seminars 4 teaching hours
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	None
Overview & applicability:	This module provides important knowledge of material science and chemistry for industrial engineers.
Learning objectives / competencies:	Competence Level 2 „Understand“: • Students are able to explain the molecular structure of matter and understand the transformation of matter and energy in chemical reactions. • Students understand the building principles of atoms and molecules. • Students can explain important fundamentals of materials (technical terminology, bonds, etc.). • Students can explain the structure of metallic materials and the importance of structural defects. • Students can describe the mechanical properties of metals and important aspects of application (e.g. strengthening mechanisms). • Students can explain thermally activated processes (diffusion, recrystallisation, etc.). • Students can describe important procedures for materials testing (e.g. tensile tests, etc.). • Students can explain changes in the conditions of metals when adding alloying elements. • Students can explain the principles and applications of metals, such as ferrous and non-ferrous metals. • Students can explain the fundamentals of technical ceramics and polymers in their own words. Competence Level 3 „Apply“: • Students are able to use the electron configuration of elements and their position in the periodic table to

	predict the corresponding chemical behaviour. • Students are able to formulate situational statements about materials clearly and use the correct technical terminology. Competence Level 4 „Analyse“: • Students can categorise functions of materials in terms of their molecular structure and prevailing bonding types. • Students can independently reflect on essential and inessential aspects of technical material questions. • Students can analyse application issues. Competence Level 5 • Students can independently assess essential and non-essential aspects of materials engineering questions, and are therefore able to choose the best solution for materials-related tasks.
Course content:	Material Science: • Basics in materials science (periodic system, bonds, material classes, determining material properties) • Structure of materials • Mechanical properties of metals • Thermally activated processes • Methods of materials testing • Alloys and phase diagrams • Ferrous and non-ferrous metals • Polymers • Technical ceramics Chemistry: • Classes of matter • Atomic structure (Bohr model and wave mechanical • model) • Periodic table and periodic properties • Intra- and intermolecular chemical bonds • Basics in chemical reactions
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading:	BROWN, Theodore L., LEMAY, H. Eugene, BURSTEN, Bruce E., MURPHY, Catherine J., WOODWARD, Patrick M., STOLTZFUS, Matthew W. C, 2018. *Chemistry-The Central Science*. 14th Edition. Harlow (United Kingdom): Pearson Education. ISBN-13: 978-1-292-22122-9. ATKINS, Peter W. and JONES, Loretta, 2006. *Chemical Principles –The Quest of insight*. 7th Edition. Ney York (U.S.A.): W.H. Freeman and Company. ISBN-13 978-1-44664411--88339955--33 SHACKELFORD, James F., 2015. *Introduction to*

	Materias Science for Engineers. Eigth Edidtion. München: Pearson Studium Verlag. ISBN 978-0-273-79340-3 ASHBY, M.F. und D.R.H. JONES, 2018. *Engineering materials. An introduction to properties, applications and design: 1* [online]. Fifth edition. Amsterdam: Butterworth-Heinemann, ISBN 978-0-08-102051-7 ASHBY, M.F. und D.R.H. JONES, 2013. *Engineering materials. 2: an introduction to microstructures and processing* [online]. 4. ed. Amsterdam: Elsevier. Issn Ser. ISBN 9780080966694

Module title:	MATHEMATICS – BASIC CONCEPTS AND APPLICATIONS
Module coordinator:	Prof. Dr. rer. nat. Alexander Herzog
Lecturer(s):	Prof. Dr.-Ing. Joachim Günther Prof. Dr. rer. nat. Alexander Herzog Prof. Dr.-Ing. Matthias Rebhan External lectures
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 1st semester
Teaching method Hours per week (SWS):	Seminars, self-study, revision 4 +2 SWS
Study workload:	Attendance time: 90 hours Self-study, exam preparation: 60 hours
ECTS:	5 ECTS
Prerequisites:	Technical secondary school mathematics
Overview & applicability:	This module lays the foundations for: “Advanced Applied Mathematics”, “Data Structure and Algorithms”, “Electrical Engineering”, “Software Engineering”, “Physics”, “Data and Process Engineering” and “Machine Learning in Python”.
Learning objectives/ competencies	Competence Level 1 “Review”: • Students recall mathematical laws, principles of mathematical reasoning and properties. • Students can distinguish vectors from scalar quantities. • Students know the basic laws of linear algebra. Competence Level 2 “Understand”: • Students understand the basics principle of engineering computation. Competence Level 3 “Apply”: • Students can solve mathematical equations in all types of functions discussed in the lectures. • Students can differentiate and integrate all types of functions discussed in the lectures for both one- and multi-dimensional functions. • Students apply vector calculus. • Students apply operations of linear algebra. • Students can solve nonlinear equations by iterative numerical methods. • Students can implement differential and integral calculus on a computer. • Students are capable of processing numerical fitting procedures.

	Competence Level 4 “Analyse”: • Students can mathematize technological problems and solve the mathematical problems deduced from these. • Students discuss applications of the mathematical methods presented in the course.
Course content:	• Geometry and linear algebra • Univariate and multivariate functions • Differential calculus for univariate and multivariate functions • Integral calculus for univariate and multivariate functions
Assessment method:	Written exam Duration: 90 minutes
Literature: Recommended reading	POTTER, Merle C., LESSING, Jack. L, ABOUFADEL Edward F, 2023: *Mathematical Methods for Engineering and Science*, 2nd edition Springer Cham, ISBN: 978-3-031-26150-3 GLYN, James, 2015. *Modern engineering mathematics*. 5th edition. Pearson. ISBN: 978-1292080734 CROFT, Anthony, 2015. *Mathematics for Engineers*. 4th. edition. Pearson/Prentice Hall. ISBN 978-1292077765

Module title:	TECHNICAL DRAWING AND CAD
Module coordinator:	Prof. Dr.-Ing. Robert Meier-Staude
Lecturers:	Prof. Dr.-Ing. Joachim Günther Prof. Dr.-Ing. Eckhard Hoffmann Prof. Dr.-Ing. Robert Meier-Staude Prof. Dr.-Ing. Bernd Schulz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 1st semester
Teaching method Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, lecture preparation,exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basic technical knowledge of mechanical engineering, machine components and manufacturing processes (drilling, turning, milling, grinding) from an industrial internship prior to studies.
Overview & applicability:	This course is fundamental to the modules “Engineering Mechanics”, “Machine Components” and “Integrated Product Design”.
Learning objectives/competencies:	Competence Level 1 "Review": Students are familiar with the principles of drawing and tolerance of component dimensions in accordance with standards. Competence level 2 "Understand": Students are able to interpret and explain technical drawings of components and assemblies. Competence level 3 "Apply": Students are able to draw/sketch three-dimensional components from each dimensional viewpoint (section) using pencil and paper. They can then transfer these representations into solid models in a 3D CAD system and derive standard-compliant technical drawings from them. Competence level 4 and 5 "Analyse and Assess": Students can use technical drawings to analyse and assess the function, manufacture and assembly of components. Competence level 6 "Create": Students use a 3D CAD system to design and engineer assemblies and compile an associated bill of materials, as well as derive technical drawings.

Course content:	• Creating technical drawings • Principles of tolerance and dimensioning • ISO fitting system and specifications of surface qualities • Representation of standardized machine elements • Introduction to the operation of a 3D CAD system • Designing individual parts, assemblies and parts lists with the aid of the CAD system • Working on a design project in a team using a 3D CAD system
Assessment method:	Written exam (wEx) and Practical Exam (praE) involving several assignments during the semester Written exam Duration: 60 minutes Further details to be given by the lecturer.
Literature/ Recommended reading:	ANZINGER, Manfred: *Technical Drawing*. 9th edition, Faculty-internal lecture notes, 2019. GOMERINGER, Roland et. al: *Mechanical and Metal Trades Handbook*, 4th edition 2018, Verlag Europa Lehrmittel LABISCH, Susanna: *Technisches Zeichnen - Eigenständig lernen und effektiv üben* 5. Aufl. 2017, Springer Fachmedien Wiesbaden.

3.2 Mandatory Modules Semester 2

Module title:	ADVANCED APPLIED MATHEMATICS
Module coordinator:	Prof. Dr. rer. nat. Alexander Herzog
Lecturer(s):	Prof. Dr.-Ing. Joachim Günther Prof. Dr. rer. nat. Alexander Herzog Prof. Dr.-Ing. Matthias Rebhan
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 2nd semester
Teaching method/ Hours per week (SWS):	Seminars/self-study/revision 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Mathematics – Basic Concepts and Applications
Overview & applicability:	This module lays the foundations for: “Data Structure and Algorithms”, “Electrical Engineering”, “Software Engineering”, “Physics”, “Data and Process Engineering” and “Machine Learning in Python”
Learning objectives/ competencies	Competence Level 1 “Review”: • Students recall that within the set of real numbers there are polynomial equations which may not be solved. • Students recall that analytical solutions to mathematical problems are seldom. • Students have a basic knowledge of probabilistic processes. Competence Level 2 “Understand”: • Students understand the basic ideas and arithmetic operations of complex numbers. • Students understand the principle of differential equations. • Students can trace back computational number representations to the methods discussed in Mathematics I. Competence Level 3 “Apply”: • Students can execute arithmetic operations of complex numbers. • Students can draw sketches of complex numbers in the complex number plane. • Students can solve algebraic equations within the set of complex numbers.

	• Students can solve differential equations of first and second order with and without perturbations. • Students can calculate the probability of an outcome of stochastic processes. Competence Level 4 “Analyse”: • Students can mathematize technological problems and solve the mathematical problems deduced from these. • Students discuss applications of the mathematical methods presented in the course. • Students analyse confidence intervals connected to stochastic processes.
Course content:	• Complex numbers and complex calculus • Differential equations • Probability theory and statistics
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading:	POTTER, Merle C., LESSING, Jack. L, ABOUFADEL Edward F, 2023: *Mathematical Methods for Engineering and Science*, 2nd edition Springer Cham, ISBN: 978-3-031-26150-3 GLYN, James, 2015. *Modern engineering mathematics*. 5th edition. Pearson. ISBN: 978-1292080734 CROFT, Anthony, 2015. *Mathematics for Engineers*. 4th edition. Pearson/Prentice Hall. ISBN 978-1292077765 PHILLIPS, G. M and TAYLOR P. J., 1999. *Theory and Applications of Numerical Analysis*. 2nd edition. Elsevier Academic Press. ISBN 978-0-12-553560-1

Module title:	BASICS OF TECHNICAL MECHANICS
Module coordinator:	Prof. Dr.-Ing. Eckhard Hoffmann
Lecturer(s):	Prof. Dr.-Ing. Markus Däubel Prof. Dr.-Ing. Joachim Günther Prof. Dr.-Ing. Eckhard Hoffmann Prof. Dr.-Ing. Sebastian Pflaum Prof. Dr.-Ing. Bernd Schulz Prof. Dr.-Ing. Robert Meier-Staude
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 2nd semester
Teaching method / Hours per week (SWS):	Seminars 4 teaching hours
Study workload:	Attendance time: 60 hours Self-study, lecture preparation, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	• Basic knowledge of and fundamentals in mathematics and physics • Basics in vector analysis, linear equation systems and differential calculus
Overview & applicability:	This module is based upon the modules “Technical Drawing”, “Material Science” and “Mathematics” and sets the prerequisites for the modules “Machine Components” and “Integrated Product Design”.
Learning objectives / competencies:	Competence Level 1 “Review”: Students review their existing knowledge of physics and mathematics and recognise its significance to studying engineering. Competence Level 2 “Understand”: Students understand the effect of forces and moments in rigid bodies and can find the resultant loads. Competence Level 3 “Apply”: Students are able to apply both graphic and analytic methods to solving mechanical problems. Competence Level 4 “Analyse”: Students are able to convert a mechanical system into a basic and simplified calculation model. Competence Level 5 “Assess”: Students are able to evaluate the results of their calculation and assess the general suitability and durability of components.

Curriculum / course content:	• Statics: Newton's axioms, the resultant in a coplanar system of forces, free body diagram, support reactions, equilibrium systems, static and kinetic friction. • Fundamentals of strength of materials: definition of stress and strain; Hooke's law; stress resultants; centroid and area moment of inertia; loads comprised of tension/compression, bending, shear, torsion and thermal stresses; stress equivalents. • Influence factors for static and dynamic strength. • Practical application of the shape strength diagram.
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading:	ANZINGER, Manfred, *Engineering Mechanics*. 9th ed., Faculty-internal lecture notes, 2017. GROSS, Dietmar et al. *Engineering Mechanics 1 – Statics*. 2nd ed. Berlin: Springer, 2013. ISBN 978-3642303180 GROSS, Dietmar et al. *Engineering Mechanics 2 – Mechanics of Materials*. 2nd ed. Berlin: Springer, 2018. ISBN 978-3662562710 KESSEL, Siegfried and Dirk FRÖHLING. *Technische Mechanik – Engineering Mechanics*. 2nd ed. Berlin: Springer, 2012. ISBN 978-3834817198

Module title:	DATA STRUCTURES AND ALGORITHMS
Module coordinator:	Prof. Dr.-Ing. Olav Hinz
Lecturer(s):	Prof. Dr. Klaus Brunner Prof. Dr.-Ing. Olav Hinz Prof. Dr.-Ing. Carsten Franke
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 2nd semester
Teaching method/ Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	None
Overview & applicability:	This module is fundamental to the modules: “Software Engineering”, ”Data and Process Engineering”, “Machine Learning in Python” and “Industrial Internet of Things.”
Learning objectives/competencies:	Competence Level 1 “Review”: Students recall and review the main data structures and algorithms. Competence Level 2 “Understand”: Students understand how different data structures are built and how runtimes are evaluated. Competence Level 3 “Apply”: Students are able to select and apply the right data structures and algorithms to given problems. They can also adapt to different problems. Competence Level 4 “Analyse”: Students are able to evaluate the runtime and the memory demand of various data structures and algorithms. Competence Level 5 “Assess”: Students are able to generate Python codes themselves, implementing the learned data structures and algorithms.

Curriculum/course content:	• Linked lists (uni- and bi-directional); Arrays • Various sorting algorithms and their complexity (Landau symbols) • Trees and graphs; how to build directed and non-directed graphs in Python • Breadth and depth first search algorithms • Shortest path algorithms • Minimum spanning tree algorithms • Introduction to greedy algorithms
Assessment method:	Written exam Duration: 90 minutes
Literature/ Recommended reading:	SANDERS, Peter et al. *Sequential and Parallel Algorithms and Data Structures*. Springer Nature Switzerland, Cham, 2019. ISBN 978-3030252113 HEINEMAN George T. et al. *Algorithms in a Nutshell: A Practical Guide O'Reilly*, 2016. ISBN 978-1491948927 LEE, Kent D., HUBBARD, Steve *Data Structures and Algorithms with Python*. Heidelberg: Springer, 2015. ISBN 978-3031422089 STEPHENSON, Ben. *The Python Workbook*. 2nd ed. Cham: Springer, 2019. ISBN 978-3030188726

Module title:	FUNDAMENTALS OF ELECTRICITY
Module coordinator:	Prof. Dr.-Ing. Johann Glas
Lecturer(s):	Prof. Dr.-Ing. Johann Glas Prof. Dr.-Ing. Marc Lotz Prof. Dr.-Ing. Sven Hawer
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 2nd semester
Teaching method/ Hours per week (SWS):	Seminars/self-study/revision 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basic knowledge of and fundamentals in physics and mathematics, esp. linear equation systems, differential calculus and complex numbers.
Overview & applicability:	This module is fundamental to the module “Control technology and smart grids”
Learning objectives/ competencies	Competence Level 1 “Review”: Students recall and review physical and mathematical laws, principles and methods fundamental to electrical engineering Competence Level 2 “Understand”: • Students understand the basics of electronic circuits and can explain the characteristics of current and voltage in series, parallel and combined connections • Students understand basic principles of semiconductors, digital technology and can classify transistor types Competence Level 3 “Apply”: • Students apply voltage and current dividers in direct and alternating current as well as electrostatics • Students determine functions of AC current and voltage using phasor diagrams and calculations with complex numbers. Competence Level 4 “Analyse”: Students can analyse magnetic und electric circuit networks by applying Kirchhoff’s laws
Curriculum/content:	• Direct current theory: current and voltage, simple circuits, network analysis, equivalent voltage sources • Electrostatics and electromagnetism: physical fundamentals, charge equalization, capacitance and inductance, law of induction, electric motors, generators, transformers • Alternating current theory: (complex) calculation methods, phasor diagrams, network analysis, generation of AC, res-

	onance angular frequency, reactive current compensation • Semiconductors and digital technology: pn-junction, function and types of transistors, digital switches and circuits
Assessment method:	Written exam Duration: 90 minutes
Literature/ Recommended reading:	PURCELL, Edward M., 2013: *Electricity and Magnetism, 3rd revised Edition.* Cambridge University Press. ISBN: 978-1-107-01402-2 HAMBLEY, Allan R. 2017: *Electrical Engineering: Principles and Applications, 7th edition*. Upper Saddle River, N.J.: Pearson Prentice-Hall. ISBN: 978-0134484143 HAGMANN, Gert, 2013. *Grundlagen der Elektrotechnik.*16. Auflage. Graz: AULA-Verlag. ISBN: 978-3891047798 ZASTROW, Dieter, 2014. *Elektrotechnik*. 19. Auflage. Wiesbaden: Springer-Vieweg Verlag. ISBN: 978-3834800992 FELLEISEN, Michael, 2016. *Elektrotechnik für Dummies*. 1. Auflage. Weinheim: Wiley-VCH Verlag GmbH & Co.KGaA. ISBN 978-3527710379

Module title:	INTERCULTURAL AND INTERPERSONAL COMPETENCES
Module coordinator:	Prof. Dr. oec. Christina Rothhaar
Lecturer(s):	Prof. Dr. oec. Christina Rothhaar Further lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 2nd semester
Teaching methods: Hours per week (SWS):	Seminars, role-play, group and team work, case studies, reflection and discussion 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study and revision: 90 hours
ECTS:	5 ECTS
Prerequisites:	This module builds on ″Advanced International Business English″ in the first semester.
Overview & applicability:	This module is focused on the soft skills necessary for interacting successfully in an international, virtual and intercultural business context.
Learning objectives/competencies:	Competence Level 1 “Reflect”: Students recall and review their own experiences in international contexts and intra- and intercultural encounters. Competence Level 2 “Understand”: Students take an open and non-judgemental perspective on the behaviour of persons from other cultures and are aware of their own cultural filter (values, beliefs and behaviour patterns). They understand the cultural specifics of German culture and those of other countries. Competence Level 3 “Apply”: Students apply personal communication and metacommunication techniques in case studies and simulations. They know how to appropriately use communication technology in virtual teams. Competence Level 4 “Analyse”: Students interpret the behaviour of persons from other cultures in an international business context using cultural dimensions (e.g. Hofstede’s and Hall’s approach) without stereotyping. Competence Level 5 “Assess”: Students can evaluate communication processes in case studies and simulations in an international business context and reflect on their own project work and team development process in intercultural learning teams. Competence Level 6 “Create”: Students know how to prepare for intercultural situations in international companies and can act appropriately and successful-

	ly in unexpected and difficult situations in intercultural encounters.
Curriculum/content:	• Intercultural theory • Cultural self-awareness and reflection on one's own personality and culture • Communicative competence and metacommunication in an international context: politeness, active listening, productively disagreeing, criticising, refusing • Country specifics • Critical incidents in international business and intercultural encounters
Assessment method:	Course work assessment (ModA)
Literature/ Recommended reading:	CALIGIURI, Paula, 2021. *Build your cultural agility. The nine competencies of successful global professionals.* London, New York: KoganPage. ISBN 978-1-78966-659-5 GIBSON, Robert, 2021. *Bridge the cultural gaps. A toolkit for effective collaboration in a diverse, global workplace.* London, Boston: Nicholas Brealey Publishing. ISBN 978-1-52938-215-0. HOFSTEDE, Geert, HOFSTEDE, Gert Jan, MINKOV, Michael, 2010. *Cultures and Organizations. Software of the mind. Intercultural cooperation and its importance for survival.* New York et al.: McGraw Hill. ISBN 978-0-07-166418-9. MEYER, Erin, 2014. *The Culture Map. Decoding how people think, lead and get things done across cultures.* New York: Public Affairs. ISBN 978-1-61039-671-4

Module title	INTERNATIONAL MARKETS AND CIRUCLAR ECONOMY (IMCE)
Module coordinator:	Prof. Dr. Tatjana Nabokin
Lecturer(s):	Prof. Dr. Tatjana Nabokin (external) Lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 2nd semester
Teaching methods: Hours per week (SWS):	Seminars, self-study, revision 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study/revision/exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	None
Learning objectives/competencies:	Competence Level 1 “Remember”: • The students know the principal methods in economics. Competence Level 2 “Understand”: • The students understand major theoretical concepts of international markets and trade. • The students understand the concepts of a sustainable circular economy. Competence Level 3 “Apply”: • The students apply economic methods to current challenges of globalization, international dependences and climate change. Competence Level 4 “Analyse”: • The students analyse the determinants for the internationalization patterns of firms and the impact of globalization. The students analyse the major challenges and opportunities of designing innovative circular business models and fostering the transition towards a sustainable circular economy.
Course content:	• Principal methods and applications of economic analysis of the production activities of firms (including production technologies, cost and profit), consumer behaviour and markets (including price formation, efficiency and welfare, perfect and imperfect competition, external effects) • Key concepts of international trade and their practical applications for the internationalization decisions of firms (including the importance of exchange rates, international policy coordination and the role of international institutions) • Challenges and opportunities of designing innovative circular business models and fostering the transition towards a circular and sustainable economy for entrepre-

	neurs, consumers, policymakers and multinationals.
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading	MANKIW, N. Gregory, and Mark P. TAYLOR, 2020. Economics, 5th edition. ORT: Cengage Learning EMEA. ISBN 978-1473768543 KRUGMAN, Paul R., Maurice OBSTFELD and Marc J. MELITZ, 2022. International economics: theory and policy. 12th edition. Harlow, England: Pearson. ISBN 978-1292409719 KOPNINA, Helen and Kim Poldner, 2021. Circular Economy: Challenges and Opportunities for Ethical and Sustainable Business, ORT: Routledge. ISBN 978-0367418649

3.3 Mandatory Modules Semester 3

Module title:	INTERGRATED PRODUCT DESIGN (CAE)
Module coordinator:	Prof. Dr.-Ing. Robert Meier-Staude
Lecturer(s):	Prof. Dr.-Ing. Joachim Günther Prof. Dr.-Ing. Robert Meier-Staude Prof. Dr.-Ing. Bernd Schulz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 3rd semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, lecture preparation, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Technical Drawing and CAD, Engineering Mechanics
Overview & applicability:	This module is complementary to all product-related topics.
Learning objectives/competencies:	Competence level 3 "Apply": Students are able to use modern CAD tools within the product development process and can apply the methods of Integrated Product Design to new development projects. Competence level 4 and 5 "Analyse and Assess": Students can use CAE and FEM to analyse and assess the component lifetime of product assemblies. Competence level 6 "Create": Students can develop new technical products using the methodology of Integrated Product Design and modern CAE tools.
Course content:	• Integrated Product Design • CAE – Computer Aided Engineering: CAD & FEA (Finite Element Analysis) • Methodological development and design • Systems engineering • Development of a product (e.g. a single-stage spur gearbox) in a small team using CAE • VDI 2221 • VDI 2206
Assessment method:	Written exam (50%) Duration: 60 minutes Practical exam (praE) (50 %) Several assignments during the semester. Further details are provided by the lecturer during the 1st lecture.

Literature/ Recommended reading:	GOMERINGER, Roland et. al: *Mechanical and Metal Trades Handbook*, 4th edition 2018, Verlag Europa Lehrmittel EHRLENSPIEL, Klaus und Harald MEERKAMM, 2017. *Integrierte Produktentwicklung*. 6. Auflage. München-Wien: Carl Hanser Verlag. 978-3-446-44089-0 EHRLENSPIEL, Klaus, 2020. *Kostengünstig Entwickeln und Konstruieren*. 8. Auflage. Berlin: Springer-Vieweg. 978-3-662-62591-0 GOMERINGER, Roland und andere, 2019. Tabellenbuch Metall. 48. Auflage. Haan-Gruiten: Verlag Europa Lehrmittel. 978-3-808-51728-4 GOMPELMANN, Marcus und andere, 2022. *Fachwissen Technische Produktdesigner 1 & 2*. 2. Auflage. Haan-Gruiten: Verlag Europa Lehrmittel. 978-3-7585-1252-0 JUNK, Stefan, 2022. *Onshape – kurz und bündig*. 4. Auflage. Wiesbaden: Springer-Vieweg. 978-3-658-36346-8 LINDEMANN, Udo, 2016. Handbuch *Produktentwicklung. 1*. Auflage. München: Hanser. 978-3-446-44518-5 WITTEL, Herbert, 2021. Roloff/Matek Maschinenelemente . 25. Auflage. Berlin: Springer-Vieweg. 978-3-658-34160-2 Supplemented by a range of relevant materials and media.

Module title:	INTERNATIONAL ACCOUNTING
Module coordinator:	Prof. Dr. Andreas Englbrecht
Lecturer(s):	Prof. Dr. Andreas Englbrecht
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 3rd semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basis knowledge of the fundamentals in International Business
Overview & applicability:	This module is fundamental to “International Financing and Investment”
Learning objectives/competencies:	Competence Level 2 “Understand”: • Students understand the principle of financial statements. • Students will be able to convert expenses from accounting to costs. Competence Level 3 “Apply”: • Students will be able to apply the basic principles and procedures of accounting. • Students will be able to prepare a profit and loss statement. • Students will be able to perform internal cost allocation using the correct procedure, depending on the type of internal activity. • Students will be able to calculate the cost of a product depending on the type of production, using the correct costing method. Competence Level 4 “Analyse”: • Students will be able to determine the amount of balance sheet items in accordance with German and international law. Competence Level 5 “Assess”: • Students will be able to assess how a balance sheet changes as a result of corporate actions. • Students will be able to assess which assets and liabilities are to be included in a balance sheet under German and international law. • Students recognize the deficits of traditional cost accounting and can provide remedial action.

Course content:	This module is divided into two parts: the preparation and interpretation of annual financial statements (Financial accounting) and the use of this information for managing a company through cost accounting (Cost accounting). Financial accounting: • Recognition and measurement of selected balance sheet items (intangible assets including R&D and goodwill, provisions, leasing, etc.) according to German GAAP (HGB) and International Financial Reporting Standards (IFRS). • Profit calculation (P&L) according to HGB and IFRS; the derivation and interpretation of key figures. • Different structuring options through accounting policies under national and international law. Cost accounting: • The classification of costs according to nature, traceability and behaviour. • The allocation of costs according to cost types, cost centres and cost objects. • Applying concepts of variable costing to decision-making (pricing decisions, break-even analysis, etc.). • The areas of application and process of activity-based costing. • The comparison of international accounting applications.
Assessment method:	Written exam Duration: 90 minutes
Literature: Recommended reading	TBD

Module title:	INTERNATIONAL MARKETING AND STRATEGY
Module coordinator:	Prof. Dr. Daniela Cornelius
Lecturer(s):	Prof. Dr. Daniela Cornelius Prof. Dr. Hermann Englberger Lecturer
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 3rd semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	The following modules: “Introduction to International Business” (Semester 1); “International Markets and the Circular Economy” (Semester 2)
Overview & applicability:	This course is a prerequisite for the module “Organizational Behaviour within International Companies” (Semester 7)
Learning objectives / competencies:	Competence Level 1 “Review”: • Students know the basic definitions and methods in international marketing (e.g. the marketing process, 4P’s). • Students know the basic concepts of strategy formulation for international companies (e.g. the definition of company targets, the strategy planning process). • Students are aware of the interconnectivity between marketing and strategy in an international company. Competence Level 2 “Understand”: • Students learn strategic thinking for an international company. • Students can formulate marketing strategies for an international company. Competence Level 3 “Apply”: • Students apply international marketing and strategy theory to real-life case studies, through project work and simulation, and make their own decisions. Competence Level 4 “Analyse”: • Students are able to perform strategic and marketing data analysis for an international company (e.g. competitor benchmarking, customer feedback analysis). Competence Level 5 “Assess”:

	• Students can review and assess the quality and success of their strategic and marketing decisions for an international company. Competence Level 6 “Create”: • Students generate superior strategic and marketing strategies based on lessons learned and can develop a target picture for the future of an international company.
Course content:	• Formulation of strategy and marketing and their interconnectivity for an international company • Basic strategy concepts for an international company (e.g. drawing up company targets, the selection of a corporate strategy, the strategy implementation process) • Marketing concepts for an international company, e.g. the marketing process, 4 P’s (product, price, place, promotion), international vs. local approach • Strategy and marketing analysis tools, e.g. the market cycle, SWOT analysis, BCG matrix Conceptual tools for team management (e.g. team charters, feedback concepts
Assessment method:	Module work (ModA) 1. Written assignment Students work on projects in teams and document/consolidate their international strategy and marketing plan, analysis, and learnings in written form. Each team member contributes approx. 10 pages. 2. Presentation Each team member gives a presentation (approx. 10 minutes) on their project work. Further details will be provided in the first seminar.
Literature/ recommended reading:	COLLINSON, Simon, et al., International Business, 8th ed., Harlow: England, Pearson, 2020, ISBN 9781292274164 GRÜNIG, Rudolf, et al., The Strategy Planning Process, 3rd ed., Cham: Germany, Springer, 2022, ISBN 9783030939182 KOTLER, Philip, et al., Marketing Management, 4th ed, Harlow: England, Pearson, 2019, ISBN 9781292248479 PIDUN, Ulrich, et al., Corporate Strategy: Theory and Practice, Wiesbaden: Germany, Springer, 2019, ISBN 9783658254261 SCHLEGELMILCH, Bodo, Global Marketing Strategy: An Executive Digest, Cham: Germany, Springer, 2022, ISBN 9783030906658 Further details will be given by the lecturer(s) during the course.

Module title:	MACHINE COMPONENTS AND DEVICES
Module coordinator:	Prof. Dr.-Ing. Eckhard Hoffmann
Lecturer(s):	Prof. Dr.-Ing. Markus Däubel Prof. Dr.-Ing. Joachim Günther Prof. Dr.-Ing. Eckhard Hoffmann Prof. Dr.-Ing. Sebastian Pflaum Prof. Dr.-Ing. Bernd Schulz Prof. Dr.-Ing. Robert Meier-Staude
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 3rd semester
Teaching method: Hours per week (SWS):	Seminars 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, lecture preparation, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basic knowledge of and fundamentals in mathematics and physics
Overview & applicability:	This course is based on the following modules: “Technical Drawing” and, in part, “Engineering Mechanics”. It is also a prerequisite for the module “Integrated Product Design”.
Learning objectives / competencies:	Competence Level 2 “Understand”: Students recognize the boundary conditions of the design in different joint technologies. Competence Level 3 “Apply”: • Students are able to select a suitable type of joint technology for a given machine or function. • Students can recalculate different joints and machine components based on simple formulae. Competence Level 4 “Analyse”: Students are capable of analysing the mechanical principle of a technical design and can derive the mechanical model. Competence Level 5 “Assess”: Students are able to define criteria and to evaluate the applicability of the different machine components in mechanical designs.
Course content:	• Features of detachable connections such as axles, shafts, pins, screws, nuts, bolts, etc. • Features of permanently connected joining techniques such as welding, soldering, bonding. • Methods of calculation for different joining techniques. • Design and calculation of shaft-to-hub connections. • Features and calculation of elastic springs, antifriction bear-

	ings, gears and transmission boxes, belts and chains, couplings and brakes.
Assessment method:	Written exam Duration: 90 minutes
Literature / Recommended reading:	BUDYNAS, Richard G., 2011. *Shigley´s Mechanical Engineering Design.* Ninth Edition in SI Units. New York, 2011, McGraw-Hill Companies, Inc., ISBN 978-007-132840-1 NIEMANN, G., WINTER, H. und HÖHN, B.-R., 2005. *Maschinenelemente Band 1: Konstruktion und Berechnung von Verbindungen, Lagern, Wellen.* 4. Auflage. Berlin, Heidelberg, 2005, ISBN 3-540-25125-1 ROLOFF, MATEK, 2011: *Maschinenelemente*: Normung, Berechnung, Gestaltung. 20. Auflage. Wiesbaden, 2011, Vieweg+Teubner Verlag/ Springer-Fachmedien, ISBN 978-3-8348-1454-8 DECKER, K.-H., 2011. *Maschinenelemente: Funktion, Gestaltung und Berechnung.* 18., aktualisierte Auflage. München, 2011, Carl Hanser Verlag, ISBN 978-3-446-42608-5 GOMERINGER, R., et. al., 2014. *Tabellenbuch Metall*. 46. Auflage. Haan-Gruiten, 2014, Verlag Europa-Lehrmittel. ISBN 978-3-8085-1726-0

Module title:	PHYSICS
Module coordinator:	Prof. Dr. rer. nat. Markus Mauerer
Lecturer(s):	Prof. Dr. rer. nat. Alexander Herzog Prof. Dr. rer. nat. Markus Mauerer Prof. Dr. Ing. Matthias Rebhan (external) lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 3rd semester
Teaching method: Hours per week:	Seminars 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, physical experiment and video creation, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basic knowledge of differential and integral calculus, as well as vector algebra
Overview & applicability:	This course is based on the following modules: “Mathematics – Basic”, “Advanced Applied Mathematics”, "Data Structures and Algorithms" and in part of "Basics of Technical Mechanics". The module is fundamental for the modules “Control Engineering and smart grids” and “Industrial Internet of Things”.
Learning objectives / competencies:	Competence Level 1 "Review": • Students know the basic laws of physics. • Students understand the importance of physics as the scientific basis of engineering. Competence Level 3 "Apply": • Students are able to solve physics problems through calculations. • Students are able to investigate possible engineering innovations in terms of physical laws. Competency Level 4 "Analyse": • Students can systematically analyse physical-technical problems by recognizing, formulating, and applying basic laws and transferring them into mathematical Language of instruction. • Students are able to evaluate and present the results of a self-conducted experiment.
Course content:	Mechanics: • free fall and inclined throw

	• motion in 3 dimensions • cyclic motion • dynamics of a point mass – Newton´s laws • momentum and conservation of momentum • forces • work • energy and energy conservation • power • dynamics of rigid bodies Thermodynamics: • the ideal gas model • laws of thermodynamics • enthalpy and useful work • entropy • ideal cyclic processes of ideal gases • real gases, example: water • gas-vapour mixtures, example: moist air Practical work: • experiments in the field of mechanics and/or thermodynamics
Assessment method:	Written exam (50 %) Duration 60 minutes Module work (ModA) (50 %): The students carry out an experiment and document their actions and results in a video they create themselves. Further details will be given by the lecturer in the lecture.
Literature / Recommended reading:	TIPLER, Paul A. and Gene MOSCA, 2020. *Physics for Scientists and Engineers*. 6. ed. London: Macmillan Education. ISBN 10: 1319365817 DEHLI, Martin, Ernst DOERING and Herbert SCHEDWILL, 2023. *Fundamentals of Technical Thermodynamics.* 1st ed. Wiesbaden: Springer Fachmedien GmbH. ISBN 978-3-658-38909-3

Module title:	SOFTWARE ENGINEERING
Module coordinator:	Prof. Dr. Klaus Brunner
Lecturer(s):	Prof. Dr. Klaus Brunner Prof. Dr.-Ing. Carsten Franke Prof. Dr.-Ing. Olav Hinz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 3rd semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basis knowledge of and fundamentals in mathematics, data structures and algorithms
Overview & applicability:	This module is fundamental to: “Distributed Systems”, “Production Technologies”, “Energy Technologies”, “Human Factors in Engineering”, “Entrepreneurial Thinking”
Learning objectives / competencies:	Competence Level 1 “Review”: Students remember technical terms and acronyms of the trade. Competence Level 2 “Understand”: Students understand roles, process definitions, and the problems they address • Students understand the purpose of SDLC tools and deliverables Competence Level 3 “Apply”: • Students are able to apply software engineering methods and tools to create deliverables (such as requirements documentation, specification, models, estimates, code) Competence Level 4 “Analyse”: • Students are able to derive requirements from a product vision. • Students are able to derive a functional breakdown and basic architecture from requirements Competence Level 5 “Assess”: • Students are able to estimate the amount of work needed. • Students are able to assess an actual software development process and point out issues
Course content:	• Introduction to the software development lifecycle (SDLC). • Fundamentals of requirements engineering.

	• Introduction to modelling techniques (UML). • Basic knowledge of software architecture (components and interfaces). • Introduction to quality control of software (verification and validation, testing) • Introduction to software development process models (traditional and agile) • Introduction and practical use of software engineering tools for requirements management, modelling, version control, build, test, and deployment.
Assessment method:	Modul work, project work Students are expected to work in groups to complete several practical assignments on the various phases of the SDLC, culminating in a brief written report and presentation. Details will be provided in due course.
Literature / Recommended reading:	SOMMERVILLE, Ian. *Engineering Software Products: An Introduction to Modern Software Engineering.* Pearson, 2020. ISBN 978-1-292-37635-6 DAVIS, Barbee *97 Things Every Project Manager should know*. O'Reilly, 2009. ISBN 978-0596804169 KIM Gene et al. *DevOps Handbook 2nd ed.* IT Revolution Press 2021, ISBN 978-1950508402 MILES, Russ *Learning UML 2.0: A Pragmatic Introduction to UML*. O'Reilly, 2006. ISBN 978-0596009823 MONSON-HAEFEL, Richard *97 Things Every Software Architect should know*. O'Reilly, 2009. ISBN 978-0596522698 PATTON, Jess et al. *User Story Mapping*. O'Reilly, 2014. ISBN 978-1491904909

3.4 Mandatory Modules Semester 4

Module title:	CONTROL TECHNOLOGY AND SMART GRIDS
Module coordinator:	Prof. Dr.-Ing. Johann Glas
Lecturer(s):	Prof. Dr.-Ing. Carsten Franke Prof. Dr.-Ing. Johann Glas (external) lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 4th semester
Teaching method: Hours per week (SWS):	Seminars, supported by laboratory practical courses 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Fundamentals in mathematics, physics and electrical engineering
Overview & applicability:	As this module is at the end of the study, its content addresses the needs of industry on completion of the degree course.
Learning objectives / competencies:	Competence Level 1 “Knowledge”: • Students recall the topology of traditional power grids and know the main voltage level setups. • The students are familiar with the technical terms and the most important forms of presentation and description of control technology. Competence Level 2 “Understand”: • The students know the differences and the application of open and closed loop controls. • The students understand the different levels of abstraction in complex systems. • Students understand the various constraints from power generation to power consumption in a connecting grid. • Students understand the challenges of integrating renewables into power grids. • Students can describe typical power system applications and their interaction. Competence Level 3 "Apply": • Students are able to optimize the usage of energy storage in some electrical network setups • Students can specify a communication scheme for existing power grids • Students are able to set up the transfer behavior of a control loop.

	Competence Level 4 "Analyze": • Students can analyze how an electrical system is setup and provide the resulting system perspective • Students can analyze unknown systems and describe their dynamic behavior. • Student can select and tune suitable controllers for closed loops. Competence Level 5 "Assess": • The students can assess the stability and quality of a control system.
Course content:	Control Technology - Introduction to closed loop control - Systems theory: • Description of dynamical systems • Mathematical system description - Basics of closed loop control • Characteristics of functional units in control systems • Stability of closed control loops • Continuous closed loop controllers: selection and tuning • Extended control loop structures • Discontinuous controllers • Simulation of closed loops • Components of process control system - Laboratory practical course • Generator voltage control Management of Electrical Powers Systems - Foundations of power systems • From generation to consumption • Considerations and implications on different voltage levels • Specific power systems constraints • Integration and optimization of energy storage solution - Sensors and actor in electrical networks • Sensor technology • Data acquisition • Actor options - Control and optimization of power systems • Practical system thinking applied to power systems • Communication in and between power systems • Integration of renewables • Typical power system applications - Laboratory practical courses • Monitoring and forecasting of a small solar power station • Network Manager Demonstrator
Assessment method:	Oral exam (Duration: 25 minutes) 80% Module work (ModA) 20%
Literature / Recommended reading:	BOLTON, William, 2019. *Mechatronics: electronic control systems in mechanical and electrical engineering*. 7th edition. Harlow, New York: Pearson. ISBN 978-1-292-25097-7 (Print) 978-1-292-25100-4 (Online)

	GOLNARAGHI, F., KUO, B., 2017. *Automatic control systems*. 10th edition. New York: McGraw Hill Education. ISBN 978-1-259-64383-5 Electric Power Systems by B.M. Weedy and B.J. Cory, Wiley, 5th Edition, 2012. ISBN 978-0470682685 Electric Power System Applications of Optimization, by James. A. Momoh, 2nd Edition, 2019. ISBN 978-0367386160 Electricity Distribution Network Design (IEE Power Engineering Series), by E. Lakervi and E.J. Holmes, 2nd Edition, 1995. ISBN 978-0863413087

Module title:	DATA AND PROCESS ENGINEERING
Module coordinator:	Prof. Dr.-Ing. Carsten Franke
Lecturer(s):	Prof. Dr. Klaus Brunner Prof. Dr.-Ing. Carsten Franke Prof. Dr.-Ing. Olav Hinz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 4th semester
Teaching method/ Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Module: “Data Structures and Algorithms”
Overview & applicability:	This course is beneficial to the modules “Machine Learning in Python” and “Industrial Internet of Things”
Learning objectives/competencies:	Competence Level 1 “Review”: Students recall and review all main elements of ERMs and BPMN elements. Competence Level 2 “Understand”: Students understand the process of database generation from the problem to tables. Competence Level 3 “Apply”: • Students are able to use different notations for ERM models. • Students can perform some SQL statements on a given database. Competence Level 4 “Analyse”: • Students are able to read and understand a given ERM and the assumptions from the real world problem. Competence Level 5 “Assess”: • Students are able to generate Entity Relationship Models for given problems. • Students can translate an ERM into database tables. • Students can generate a BPMN for a given process.
Course content:	• Generation of Entity Relationship Models from a real-life business case • Transformation of ERM into a database schema • Application of SQL to a given database to in-sert/modify/extract certain information • Introduction of alternative database concepts to address Big Data and AI problems

	• Discussion of processes in enterprises and how to derive and manage such processes • Generation of BPMN solutions for various business processes with increasing complexity
Assessment method:	Written exam Duration: 90 minutes
Literature/ Recommended reading:	WESKE, Mathias, *Business Process Management – Concepts, Language of instructions, Architectures*. 3rd ed., Springer, 2019. ISBN 78-3662695173 ITL Educations Solution Limited. *Introduction to Database Systems*. PEARSON, 2010. ISBN 978-8131731925

Module title:	HUMAN FACTORS ENGINEERING (HFE)
Module coordinator:	Prof. Dr. Johannes Brombach
Lecturer(s):	Prof. Dr. Johannes Brombach Prof. Dr. Sven Hawer
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 4th semester
Teaching method: Hours per week (SWS):	Seminars/self-study/revision 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study/revision/exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Language of instruction proficiency of B2 in Business English (cf. Common European Framework of Reference, CEFR)
Overview & applicability	This module focuses on skills needed for industrial engineers to successfully analyze, evaluate and design human-machine interface systems.
Learning objectives/competencies:	On successful completion of this course, all students will have further developed and mastered key areas of human factors in engineering: Competence level 1 “Revision (Knowledge)”: Tactile, visual, auditory, and informal interfaces between humans and their environment and human augmentation technology. Competence level 2 “Understand”: Basics of operating concepts and software design; cognitive psychology considerations. Competence level 3 “Understand”: Models of human work and simulation of processes as well as user group dependencies (age, gender, power conversion, etc.) Competence level 4 "Analyze" and 5 "Evaluate": Evaluate the interface in human-machine systems, taking into account biomechanical, receptor and informational conditions Competence level 6 “Create”: Create an independent research question and develop a human-machine design to address the given problems.

Course content:	Interactions between human-environment and human-machine process design: • Basics and fundamentals of human factor engineering • Informational: tactile, visual, acoustic • Energetic: biomechanical, thermoregulatory • Climate and clothing • Simulation of processes • Collaborative robots (cobots) Product design: • Actuating and operating parts • Displays and input devices • Software ergonomics (GUI) • Digital assistance systems (AR/VR) • Human augmentation technology (exoskeletons) • Working with AI, applications and solutions
Assessment method:	Module work (ModA) Students work in a team to complete a human-machine design task. Presentation of the problem, design concept and project management are part of the grading scheme. Several short written evaluations during the semester ensure that the course content has been covered. Further details to be given by the lecturer.
Literature/ Recommended reading:	BULLINGER-HOFFMANN, A.C.; MÜHLSTEDT, J. (Hrsg.) , 2016: Homo Sapiens Digitalis — Virtuelle Ergonomie und digitale Mensch-Modelle. Springer, Berlin, Heidelberg. BULLINGER, H.-J., 1994. Ergonomie – Produkt- und Arbeitsplatzgestaltung. Stuttgart: B.G. Teubner Verlag, SCHLICK, BRUDER, LUCZAK, 2010: Arbeitswissenschaft. Springer, Heidelberg. SCHMAUDER, M. und B, SPANNER-ULMER, 2022: Ergonomie: Grundlagen zur Interaktion von Mensch, Technik und Organisation - Hanser Fachbuchverlag. SCHMIDTKE, H. und I, JASTRZEBSKA-FRACZEK, 2013. Ergonomie: Daten zur Systemgestaltung und Begriffsbestimmungen. Carl Hanser Verlag GmbH Co KG. KLUTH, K. and H. STRASSER, 2003. Subjective Evaluation of a Newly Developed Scanner Checkout in Comparison with a Conventional Cash Register System via Standardized Working Tests. In: STRASSER, H.; KLUTH, K.; RAUSCH, H. and H. BUBB (Eds.): Quality of Work and Products in Enterprises of the Future. 275-278. Stuttgart: Ergonomia Verlag. WINDEL, A., 2019. Arbeitsmedizin, Bundesanstalt für Arbeits-

	schutz und: Kleine Ergonomische Datensammlung. 17. Aufl., Köln: TÜV Media GmbH.

Module title:	PROCUREMENT AND SUSTAINABILITY
Module coordinator:	Prof. Dr.-Ing. Klaus-Jürgen Meier
Lecturer(s):	Prof. Dr.-Ing. Klaus-Jürgen Meier Prof. Dr.-Ing. Christoph Nerl
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 4th semester
Teaching methods: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	None
Overview & applicability:	
Learning objectives/competencies:	This module is designed to achieve the following learning objectives in the area of procurement and sustainability: Competence Level 2: Understand Relation and interaction between modern procurement and sustainability Competence Level 3: Apply Methods of risk management and be able to carry out a risk assessment in the field of purchasing Competence Level 3: Apply Different strategic approaches as well as procurement instruments and apply these correctly in specific situations Competence Level 3: Apply Contents of the Supply Chain Act and be able to implement the requirements in accordance with the law Competence Level 3: Apply Tools and procedures of e-procurement and be able to plan their application Competence Level 4: Analyse Cost drivers in procurement processes and identify the total cost of ownership Competence Level 3: Apply Experience based on best practice examples to application strategies
Curriculum/content:	• Introduction to procurement and global sourcing • Procurement forms and strategies

	• Total cost of ownership in procurement • Procurement and sustainability • Supply Chain Act • Risk management in procurement • Supplier selection • Methods and tools of e-procurement
Assessment method:	Written exam Duration: 60 minutes
Literature / Recommended reading:	WEIGEL, Ulrich und RUECKER, Marco, 2017. *The Strategic Procurement Practice Guide: Know-how, Tools and Techniques for Global Buyers.* Wiesbaden: Springer. ISBN 978-3-319-57650-3 SCHUH, Christian et al., 2017. *The Purchasing Chessboard: 64 Methods to Reduce Costs and Increase Value with Suppliers.* 3rd ed. New York: Springer. ISBN 978-1-4939-6763-6

Module title:	PRODUCTION TECHNOLOGIES AND APPLICATIONS
Module coordinator:	Prof. Dr.-Ing. Christoph Nerl
Lecturer(s):	Prof. Dr.-Ing. Christoph Nerl
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 4th semester
Teaching method Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Private study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	The following modules: “Material Science and Chemistry”, “Technical Drawing and CAD”, “Machine Components”
Overview & applicability:	This course is not a prerequisite for other modules.
Learning objectives / competencies	Competence Level 1 “Review”: • Students review the main properties of the most predominantly used metallic materials and recognise their significance in terms of processability. Competence Level 2 “Understand”: • Students understand the relevance of industrial production for adding value. • Students explain the characteristics of the most relevant manufacturing processes and classify them into main groups in accordance with DIN 8580. Competence Level 3 “Apply”: • Students are able to apply basic analytic methods to calculate essential process parameters. Competence Level 4 “Analyse”: • Students analyse the interaction between material selection, part design and manufacturing process. • Students carry out a technology-based selection of machines and specific tools required for the production of a given sample part. Competence Level 5 “Assess”: • Students assess manufacturing processes in terms of economic and technical issues, taking into account part specific preconditions. • Students are able to evaluate the suitability of manufacturing process simulation.
Curriculum / course content	• Primary shaping (casting, powder metallurgy, additive manufacturing) • Forming (bulk forming, sheet forming) • Cutting (cutting with geometrically defined and geometrically undefined tool edges, nonconventional processes) • Joining • Coating

	• Numerical simulation of manufacturing processes
Assessment method:	Written exam Duration: 60 minutes
Literature: Recommended reading	GROTE, Karl-Heinrich and Hamid HEFAZI, Editors, 2021. Springer Handbook of Mechanical Engineering. 2nd ed., Cham: Springer. ISBN 978-3-030-47035-7 KALPAKJIAN, Serope and Steven R. SCHMID, 2014. *Manufacturing Engineering and Technology*. 7th ed., Singapore: Pearson. ISBN 978-0-13-312874-1 NEE, Andrew Y. C., Editor, 2015. *Handbook of Manufacturing Engineering and Technology*. London: Springer. ISBN 978-1-4471-4670-4

Module title:	PRODUCTION LOGISTICS AND QUALITY MANAGEMENT (PLQM)
Module coordinator:	Prof. Dr.-Ing. Bernd Schulz
Lecturer(s):	Prof. Dr.-Ing. Bernd Schulz External lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 4th semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week: Production Logistics (2 hrs) and Quality Management (2 hrs)
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	The Production Logistics sub-module requires “Procurement and Sustainability” and supplements “Production Management and Logistics”. The Quality Management sub-module requires mathematical skills.
Overview & applicability:	The Quality Management sub-module explains the basics of quality management in projects and in production.
Learning objectives / competencies:	PRODUCTION LOGISTICS Competence level 2 “Understanding”: • Students can build up and understand the importance of parts lists. • Students understand the Queue theory with linear / nonlinear dependency of processing time and inventory. • Students know the basics for the layout planning of factories and technical logistics equipment including planning software. Competence level 3 “Apply”: Students differentiate the most common control modes in combination with differentiation of production orders. Competence level 5 “Assess”: Students can assess the correct control modes and kind of production orders for companies and its products. QUALITY MANAGEMENT Competence level 2 “Understanding”: • Students can describe the standards and requirements for quality management systems.

	• Students can explain where quality-related costs are incurred and what findings recording these costs can provide •Students understand QM systems in accordance with ISO 9000: 2000 within the company and are familiar with sector-specific requirements for QM systems. Competence level 3 “Apply”: • Students can select and apply quality methods in the product creation process, manufacturing and product application. • Students can prepare, implement machine- and process capability studies and derive measures based on the values obtained. Competence level 5 “Assess”: • Students can assess the quality of product implementation using sample systems. • Students can understand the statistical process planning and draw up and assess quality control cards.
Course content:	PRODUCTION LOGISTICS • Parts list • Differentiation of the most common control modes in combination with differentiation of production orders • Application software and software structures which are used to manage control modes and production orders • Queue theory • Basics for the layout planning of factories and technical logistics equipment. including planning software QUALITY MANAGEMENT • Quality management systems • Quality tasks within the company • Quality methods in the life cycle of projects and products • Quality assurance in production • Quality costs and quality indicators
Assessment method:	Written exam Duration: 60 minutes
Literature / Recommended reading:	WIENDAHL, H.-P., 2014. *Betriebsorganisation für Ingenieure*, 8. Auflage, München: Carl Hanser Verlag. ISBN 978-3-446-44053-1 KOETHER, R., 2011. *Taschenbuch der Logistik*, 4. Auflage, München: Carl Hanser Verlag, ISBN 978-3-446-42512-5 KUMMER, S., GRÜN, O., JAMMERNESGG, W., 2009. *Grundzüge der Beschaffung, Produktion und Logistik*, München: Pearson, ISBN 978-3-8273-7351-9 + Übungsbuch 978-3-8273-7350-2 PFEIFER, T., 2001. *Qualitätsmanagement - Strategien, Methoden, Techniken,* München: Carl Hanser Verlag. ISBN 3-446-21515-8 PFEIFER, T., 2001. *Praxisbuch Qualitätsmanagement*, München: Carl Hanser Verlag. ISBN 3-446-21508-5

3.5 Mandatory Modules Semester 5

Module title:	DISTRIBUTED SYSTEMS
Module coordinator:	Prof. Dr.-Ing. Olav Hinz
Lecturers:	Prof. Dr. Klaus Brunner Prof. Dr.-Ing. Carsten Franke Prof. Dr.-Ing. Olav Hinz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 5th semester
Teaching method: Hours per week (SWS):	Seminar-like lecture, Exercises 4 hours per week
Workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basis knowledge and fundamentals in mathematics and software engineering
Overview & applicability:	The module is fundamental for the modules , “Production technologies”, “Energy technologies”, “Human factor engineering”, “Entrepreneural thinking”
Learning objectives/competencies:	Competence Level 1 “Remember”: The students remember technical term and acronyms. Competence Level 2 “Understand”: The students understand the basic approaches. Competence Level 3 “Apply”: The students are able to apply modelling techniques. Competence Level 4 “Analyse”: The students are able to analyse a given system. Competence Level 5 “Assess”: The students are able to design a simple system.
Course content:	• Design goals • Architectures • Processes • Communication • Coordination • Naming • Consistency and replication • Fault tolerance • Security

Assessment method:	Module work In the module work, students have to work on artefacts of a distributed IT-system based on a project description. Further details are provided by the lecturer during the 1st lecture.
Literature/ Recommended +:	TANENBAUM, Andrew S. et al. *Distributed systems* 4rd ed. Maarten van Steen, 2023. ISBN 978-9081540636

Module title:	PRODUCTION MANAGEMENT AND LOGISTICS
Module coordinator:	Prof. Dr.-Ing. Sven Hawer
Lecturer(s):	Prof. Dr. Markus Däubel Prof. Dr. Sven Hawer
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 5th semester
Teaching method: Hours per week (SWS):	Seminars/self-study/revision 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study/revision/exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basic knowledge in programming, mathematics and the modules Production Logistics and Quality Management and Human Factors Engineering are required.
Overview & applicability:	This course is not a prerequisite for other modules. This module focuses on skills needed for industrial engineers to successfully manage production and logistics systems in industry.
Learning objectives/competencies:	On successful completion of this course, all students will have further developed and mastered key areas of production management: Competence level 1 “Revision (Knowledge)”: • The students remember terminology and types of production control systems and their characteristics. • They can name the 4 areas of logistics management. Competence level 2 “Understand”: • The students understand how production control systems are planned and can explain their operative function in different production principles. • They understand the importance of process simulation as a planning and evaluation tool in the production context. • The students are able to allocate relevant production and logistics planning processes within the SCOR model. • Furthermore they understand the interdependencies between lean management principles, ergonomics and production management. Competence level 3 “Apply” and level 4 “Analyse”: • The students apply value stream mapping to given practical and theoretical processes in order to optimize efficiency and avoid waste (muda) • They can methodically analyse in which use cases in pro-

	duction and logistics machine learning could yield a qualitative and economic benefit • The students apply project and quality management competencies to conduct a course work assessment (ModA) in one of the following fields of application: value stream mapping, process simulation, applied machine learning, lean ergonomics Competence level 5 “Assess” and level 6 “Create”: • The students are able to assess and optimize production systems with regard to efficiency and waste and can interpret results for small-scale use cases.
Course content:	• Types and characteristics of production control and logistics systems • Lean production principles • SCOR model as a framework • Value stream mapping • Process simulation • Case studies of machine learning in the production context • Practical module work in one of the following areas: o value stream mapping, o process simulation, o applied machine learning, o lean ergonomics
Assessment method:	Written exam Duration: 60 minutes Module work (ModA) In the module work, students have to create a report of no more than 10 pages on a topic which must be agreed on with the lecturer in advance. The results need to be presented within a 10-minutes presentation. Further details are provided by the lecturer during the 1st lecture.
Literature/ Recommended reading:	H.-P. Wiendahl, P. Nyhuis, J. Reichardt, Handbook Factory Planning and Design, Springer (Berlin) 2015, ISBN 978-3-662-46390-1 R. Koether, Taschenbuch der Logistik, Hanser (München) 2004. ISBN 3-446-22247-2 P. Schönsleben, Handbook Integral Logistics Management, 6th ed. Springer (Zürich) 2022. ISBN 978-3-662-65624-2 R. Hänggi, A. Fimpel, R. Siegenthaler, LEAN Production – Easy and Comprehensive, Springer Vieweg (Berlin) 2022. ISBN 978-3-662-64526-0 F. Bertagnolli, Lean Management. Introduction and In-Depth Study of Japanese Management Philosophy, Springer (Wiesbaden) 2022. ISBN 978-3-658-36086-3 T.-C. Toly Chen, Y.-C. Wang, Artificial Intelligence and Lean Manufacturing, Springer Nature (Cham) 2022.ISBN 978-3-031-04582-0

Module title:	INTERNATIONAL FINANCE
Module coordinator:	Prof. Dr. rer. pol. Verena McIntosh
Lecturer(s):	Prof. Dr. rer. pol. Verena McIntosh
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 5th semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	This module builds on “Basics of International Business” and “International Accounting”.
Overview & applicability:	
Learning objectives / competencies:	Competence Level 2 “Understand”: • main objectives of corporate finance • funding instruments for companies • structure of financial plans • financial models to evaluate investment cases Competence Level 3 “Apply”: • make funding decisions and investment decisions in case studies Competence Level 5 “Assess”: • assess different financing instruments according to economic criteria • evaluate feasibility of funding alternatives • evaluate suitability of different financial models for investment cases
Course content:	Funding and investing: • debt • equity • alternative forms of financing • sustainable finance • internal financing Financial planning Investment project evaluation: • static • dynamic • in a world of uncertainty

Assessment method:	Written exam Duration: 60 minutes
Literature / Recommended reading:	QUIRY, Pascal et al., Corporate Finance, 5th edition, Chichester (UK): Wiley, 2018. MOFFET, Michael H., Fundamentals of multinational finance, 6th edition, Harlow (UK): Pearson, 2021. POGGENSEE Kay and Jannis Poggensee, Investment valuation and appraisal, Springer (ebook), 2021. MAGNI, Carlo Alberto, Investment decisions and the logic of valuation, Springer (ebook)., 2020.

3.6 Mandatory Modules Semester 6

Module title:	MACHINE LEARNING IN PYTHON
Module coordinator:	Prof. Dr.-Ing. Carsten Franke
Lecturer(s):	Prof. Dr. Klaus Brunner Prof. Dr.-Ing. Carsten Franke Prof. Dr.-Ing. Olav Hinz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 6th semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Basic knowledge of and fundamentals in mathematics, data structures and algorithms.
Overview & applicability:	This module is fundamental to “Industrial Internet of things”
Learning objectives / competencies:	Competence Level 1 “Review”: Students recall technical terms and acronyms. Competence Level 2 “Understand”: Students understand the fundamental approaches to storing data. Competence Level 3 “Apply”: Students are able to apply basic methods in statistics. Competence Level 4 “Analyse”: Students are able to analyse and modify given programming codes in Python. Competence Level 5 “Assess”: • Students are able to evaluate classification and clustering algorithms. • Students are able to generate and adapt basic Neural Networks
Course content:	• Hands-on implementation of different methods in artificial intelligence using common technologies • Hands-on usage of Python Pandas for data processing • Hands-on usage of classifying methods and grouping methods • Hands-on usage of scikit-learn Python packages • Hands-on usage of Tensorflow und Keras
Assessment method:	Module work and project work

Literature / Recommended reading:	MCKINNEY, Wes, *Python for Data Analysis: Datenanalyse mit Python: Auswertung von Daten mit Pandas*, NumPy und IPython“. O’Reilly, 2018. ISBN 978-1098104030 GRUS, Joel, *Data Science from Scratch: First Principles with Python*. O’Reilly, 2019. ISBN 978-1492041139 GERON, Aurelien, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*. O’Reilly, 2022. ISBN 978-1098125974

Module title:	INTERNSHIP IN INDUSTRY
Module coordinator:	Prof. Dr. Johannes Brombach
Lecturer(s):	Prof. Dr. Johannes Brombach Prof. Dr. Andreas Rieger
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 6th semester
Teaching method: Hours per week (SWS):	Practical training
Study workload:	Attendance time: 20 weeks (4-day weeks during the semester and 5-day weeks in the semester breaks)
ECTS:	20 ECTS
Prerequisites:	Knowledge of business administration and technology from semesters 1 – 5
Overview & applicability:	The completed internship, or submission of the certificate to the Examinations Office/Academic Registry (“Prüfungsamt”), is a prerequisite for registering a Bachelor thesis.
Learning objectives/competencies:	On successful completion of the internship, all students will have further developed and mastered key areas of human factor engineering: Competence level 3 "Apply": After their industrial internship, students are able to independently and systematically apply the knowledge, skills and competencies they have acquired to practical tasks in industry. Competence level 5 "Evaluation": Students practise the contents of their studies, evaluate their own skills in practice and deepen their specific specialist knowledge through practical application. This practical study semester serves as a future professional orientation.
Course content:	This module prepares students for the interface between technology and business administration in their professional careers as industrial engineers and hones the skills needed to solve practical difficulties and problems independently. The focus is on gaining experience in areas such as: - sales and marketing - development and construction - preparation, planning, scheduling and procurement - production and service provision - quality assurance

	- customer service - accounting - organization and data processing
Assessment method:	In a colloquium, students review the practical study semester and reflect self-critically on what they have learned and its relevance to their future careers. They also share experiences and impressions with other students in the colloquium. Assessment consists of an oral report on the experience gained (approx. 5 min) and an interview about their activities at the interface between technology and business administration (approx. 5 min). It is also necessary to submit a written internship report of approx. 10 pages, which summarizes the student's experience of their traineeship. Further details to be given by the lecturer.
Literature/ Recommended reading:	BAUMGARTEN, H. und W.-Chr. HILDEBRAND, 2015: *Wirtschaftsingenieurwesen in Ausbildung und Praxis,* 14. Auflage, VWI e.V. ISBN 978-3-7983-2763-4 HERING, Ekbert, 2013. *Taschenbuch für Wirtschaftsingenieure.* 3. Auflage. Carl Hanser Verlag, München, ISBN 978-3446432529. Fakultäten-und Fachbereichstag Wirtschaftsingenieurwesen e.V., 2014. Qualifikationsrahmen Wirtschaftsingenieurwesen, 2.überarbeitete Auflage, Pforzheim Cf. FK09 website, notices and announcements.

Module title:	INDUSTRY PROJECT AND RESEARCH SKILLS
Module coordinator:	Prof. Dr.-Ing. Johannes Brombach
Lecturer(s):	Prof. Dr.-Ing. Johannes Brombach Prof. Dr.-Ing. Johann Glas Prof. Dr.-Ing. Sven Hawer Prof. Dr. rer. nat. Markus Mauerer External lecturers
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 6th semester
Teaching method: Hours per week (SWS):	Seminars/self-study/revision 4 teaching hours
Study workload:	Attendance time: 60 hours Self-study/revision/exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	Language of instruction proficiency: B2/C1 in Business English Project management
Overview & applicability:	This module focuses on the research and problem-solving skills needed for industrial engineers to successfully complete their projects in industry and academic work, including presentations, reports, outlines and theses.
Learning objectives/competencies:	On successful completion of this course, students will have further developed and mastered key areas of applied research skills: Competence Level 1 "Review": • Students review research tools for information retrieval. Competence Level 2 “Understand”: • Students understand scientific quality criteria (objectivity, validity and reliability). • Students are able to structure academic work using scientifically founded procedures. Competence Level 3 “Apply”: • Students work in teams (max. 6) on the task using classical/traditional or agile project management approaches. Competence Levels 4 "Analyse" and 5 "Assess": • Students know how to solve real-world problems in industry with a structured approach. Competence Level 6 “Create”: • Students are able to create and answer an independent research question.

Course content:	Academic research, reporting and presentation: Quality criteria in research and good scientific practice The industrial project will preferably take place in a company that ensures professional supervision after consultation with the lecturer: • Application of project management tools (traditional or agile approach) • Information retrieval and "Journal Club" • Research-based learning • Preparation of a jour fix (reporting every 2 weeks) • Documentation of project results and report writing • Preparation of a management presentation (30 min) • Defending results; managing a discussion and Q&A session
Assessment method:	Module work (ModA): Students have to find a topic of their choice during their internship program, which must be agreed upon with the lecturer. Students will receive feedback on the synopsis and defend their own arguments. Documentation: 10 pages Reporting: every 2 weeks Presentation: 30 min. Further details to be given by the lecturer.
Literature / Recommended reading:	KENNET, Brian. 2014. *Planning and Managing Scientific Research: A guide for the beginning researcher*. Canberra: ANU Press. http://www.jstor.org/stable/j.ctt6wp816 BOTTOMLEY, Jane. 2021. *Academic Writing for International Students of Science*. 2nd. edition. Milton Park: Routledge. ISBN: 9780367632724 Supplemented by a range of relevant materials and media.

3.7 Mandatory Modules Semester 7

Module title:	INDUSTRIAL INTERNET OF THINGS
Module coordinator:	Prof. Dr. Klaus Brunner
Lecturer(s):	Prof. Dr. Klaus Brunner Prof. Dr.-Ing. Carsten Franke Prof. Dr.-Ing. Olav Hinz
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 7th semester
Teaching method: Hours per week (SWS):	Seminars, exercises 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, exam preparation: 90 hours
ECTS:	5 ECTS
Prerequisites:	The following modules: “Data Structures and Algorithms”, “Software Engineering”, “Data and Process Engineering”, “Distributed Systems”
Overview & applicability:	As this module is in the final semester, its content addresses the needs of industry on completion of the degree course.
Learning objectives / competencies:	Competence Level 1 “Review”: Students review terminology and concepts of embedded / cyber-physical / IoT systems. Competence Level 2 “Understand”: Students understand the various aspects that need to be addressed to build a comprehensive embedded / IoT solution “end to end”. Competence Level 3 “Apply”: Students are able to apply fundamental design patterns and work techniques to given embedded/IoT problems. Competence Level 4 “Analyse”: Students can differentiate between various technologies and techniques for different problems and discuss possible alternatives. Competence Level 5 “Assess”: Students are able to evaluate a given IoT solution and can identify weak spots and suggest possible alternative solutions.
Course content:	• Understanding embedded (cyber-physical) systems and internet of things concepts and specific requirements • Modelling of cyber-physical systems for various applications • Industrial IoT design patterns • Communication and networking

	• Application of artificial intelligence (AI) and data analytics for manufacturing
Assessment method:	Module work, project work (in small groups) Students will work on a practical project through several life-cycle phases, culminating in a short written report and presentation. Details will be provided in due course by the instructor.
Literature: Recommended reading	MARWEDEL, P., *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things.* Fourth Edition, Springer Open Access, 2021 JESCHKE, S. at. al., *Industrial Internet of Things*, Cham, Springer, 2017. ISBN 978-3319425580 CAGANOVA, D. at. al., *Advances in Industrial Internet of Things, Engineering and Management*, Cham, Springer, 2021 ISBN 978-3030697075 KANAGACHIDAMBARESAN, G. R. et. Al., *Internet of Things for Industry 4.0*, Cham, Springer, 2020. ISBN 978-3030325299 AL-TURJMAN, F*., Edge Computing*. Cham, Springer, 2019. ISBN 978-3319990606

Module title:	BACHELOR THESIS
Module coordinator:	Supervisor (must be a professor of the Faculty of Industrial Engineering and Management)
Lecturers:	
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 7th semester
Teaching method: Hours per week:	Independent scientific work
Study workload:	Processing time: maximum of six months. Students apply for the registration of a bachelor in NINE, selecting an FK09 professor as examiner and entering the working title in English. When the thesis is submitted later, it is possible to amend the title in consultation with the supervisor. Once students have submitted the application in NINE, the examination office will check whether the prerequisite for starting the bachelor thesis (completion of the practical semester) has been fulfilled. If the prerequisite has not yet been met, students will be notified and the application put on hold. If the requirement is fulfilled, the supervisor will be informed about the bachelor thesis' proposal and notified of the request. As of the day of acceptance by the supervising professor, students must complete their thesis within six months. If the chosen professor declines to act as supervisor, or does not respond to the request for several weeks, students will be informed.
ECTS:	12 ECTS
Prerequisites:	Prerequisite for the start of a bachelor thesis is the completion of a practical semester. Colloquium and report on the practical semester can also be completed after starting the bachelor thesis.
Overview and applicability:	The module builds on the experience gained in the practical study semester. The module imparts the same competencies as the module "Bachelor thesis" in the Bachelor programmes "Industrial Engineering and Management Automotive Industry" and "Industrial Engineering and Management Logistics" as well as the module "Master's thesis" in the Master's degree programmes at FK09.
Learning objectives / competencies:	Competence Level 2 "Understanding": Students will be able to research technical literature and use technical information sources to produce work products. Competence Level 3 "Apply": Students will be able to articulate logically and persuasively in oral and written form, as well as communicate with peers about content and problems in the relevant discipline.

	Competence Level 4 "Analyse": Students will be able to collect relevant data in technical, business or interdisciplinary settings and analyse and evaluate it using scientific methods. Competence Level 5 "Evaluate": Students will be able to make decisions, develop concepts and find solutions for interdisciplinary problems using scientifically based procedures, taking into account entrepreneurial and technical conditions, and to evaluate these rationally.
Course content:	Students have the opportunity to choose a topic themselves and work on it in coordination with the supervising professor or to take on a topic offered by a professor. Topics can also be worked on in cooperation with companies.
Assessment method:	Module work (ModA) The type of presentation, extent of the thesis and form of submission (bound and/or electronic) must be coordinated with the supervising professor. The thesis must always be handed in to the secretary's office so that it can be noted in the system as having been submitted on time.
Literature / Recommended reading:	Supervisors will provide students with individual documentation of the requirements for the thesis.

Module title:	THESIS SEMINAR
Module coordinator:	Prof. Dr. Mathias Gabrysch
Lecturer(s):	
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng) 7th semester
Teaching method: Hours per week (SWS):	Seminars/self-study/revision 2 teaching hours
Study workload:	Attendance time: 30 hours Private study/revision/exam preparation: 30 hours
Credits:	2 ECTS
Prerequisites:	Language of instruction proficiency: B2/C1 in Business English; Successful participation of module “Industry Project and Research Skills”
Overview & applicability:	The seminar takes place every semester as a two-hour weekly course. Participation in the seminar sessions is compulsory.
Learning objectives/competencies:	The aim is for students to learn how to carry out independent research on scientific issues. This seminar is intended to provide students with an introduction to scientific work. Students should use this as part of their accompanying bachelor’s thesis. After successfully completing the course, students will be able to: Competency level 2 "Understand": • Students can understand “good scientific practice”. Competence Level 3 “Apply”: • Define the adequate research methodology for the thesis and apply it to data their • Collection Competence Level 4 • Students can identify and analyze specialized literature to an appropriate extent. • Analyse the collected data and structure it in such way that it provides valuable information for the thesis and can be used for conclusions Competency Level 5 "Evaluate": • Students are able to evaluate whether the methodology (research approach and findings) are consistent, and conclusions based on the methodology can be retrieved.
Course content:	In the first weeks of the semester the following topics will be discussed: • Basic methods of scientific work in a context of Bachelor thesis (structure of a scientific paper, literature research,

	correct citation, etc.). • Various research methods that are frequently used in international management and industrial or digital engineering are discussed (literature analysis, qualitative research/case studies, quantitative research/empirical research). After the theory each student will present their bachelor thesis: What is the research question and which methodology will be applied and why. The students will have the opportunity to receive additional feedback and new food for thought for their scientific work from their peer students.
Assessment method:	Module work (ModA) In the module work, students must write a report of no more than 10 pages on their thesis. The results need to be presented within a 10-minutes presentation. Further details are provided by the lecturer during the 1st lecture.
Literature / Recommended reading:	Supplemented by a range of relevant materials and media.

Module title:	ENTREPRENEURIAL THINKING
Module coordinator:	Prof. Dr. Herbert Gillig
Lecturer(s):	Prof. Dr. Herbert Gillig
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 7th semester
Teaching method Hours per week (SWS):	Seminars, exercises, project-oriented work in small groups 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, revision: 90 hours
ECTS:	5 ECTS
Prerequisites:	Completion of internship
Overview & applicability:	
Learning objectives/competencies:	On successful completion of the course, students will be able to: Competence Level 2 “Understand”: Students understand the entrepreneurship approach comprehensively and can explain it. Competence Level 3 “Apply”: Students can apply current methods and models from the field of entrepreneurship. Competence Level 4 “Analyse”: Students differentiate between the different challenges of the phases of the entrepreneurship process and can identify a relevant problem for a specific target group. Competence Level 5 “Assess”: Students can evaluate existing and new business models in terms of critical hypotheses. Competence Level 6 “Create”: Students develop a comprehensive business model for a new startup based on an identified problem, and plan the steps necessary for successful market entry, including prototyping, customer acquisition, and funding strategies.
Curriculum/content:	Students develop their own business idea in small groups in a relevant area, e.g. digital transformation in healthcare. At the same time, participants acquire theoretical knowledge throughout the entire entrepreneurship process and exchange ideas with international students at several points in the process. The module is structured as follows:

	• The entrepreneurial perspective • From problem to entrepreneurial opportunity • From business idea to business model • From planning to start-up • Life cycle and growth
Assessment method:	Module work (ModA) In their assignment, students write an approx. 15-page paper on the business idea they have developed themselves. Students then give a 15-minute presentation on the results of their projects. Further details will be given by the lecturer in the first seminar.
Literature/ Recommended reading:	NECK, Heidi M.; NECK, Christopher P.; MURRAY, Emma L., 2020. *Entrepreneurship: The practice and mindset.* Sage publications. ISBN 978-1071808078. AULET, Bill, 2013. *Disciplined Entrepreneurship.* New Jersey: John Wiley & Sons. ISBN 978-1118692288. OSTERWALDER, Alexander und Yves PIGNEUR, 2010. *Business model generation – A handbook for visionaries, game changers, and challengers.* Hoboken, NJ: Wiley. ISBN 978-3593394749. Further reading will be communicated during the course.

Module title:	ORGANIZATIONAL BEHAVIOUR WITHIN INTERNATIONAL COMPANIES
Module coordinator:	Prof. Dr. Phil. Renate Osterchrist
Lecturer(s):	Prof. Dr. phil. Renate Osterchrist Prof. Dr. oec. Christina Rothhaar
Language of instruction:	English
Degree programme:	International Management and Digital Engineering (B. Eng.) 7th semester
Teaching method: Hours per week (SWS)	Seminars 4 teaching hours per week
Study workload:	Attendance time: 60 hours Self-study, preparation, revision: 90 hours
ECTS:	5 ECTS
Prerequisites:	Intercultural and Interpersonal Competence; Internship
Overview & applicability:	
Learning objectives/competencies:	This module focuses on the individual and social skills needed within the context of international business. Competence level 2 „Understand“: Students can summarize and compare key approaches to employee and organizational development (e.g. motivation theories, team development, leadership styles) in an international context. Competence level 3 „Apply“: • Students can implement learnings from successful and unsuccessful set-ups to effect change. • Students can apply learnings from employee and organizational development approaches to case studies and simulations. Competence level 4 „Analyse“: • Students can distinguish between individual preferences. • Students can analyze personality patterns in themselves and others. • Students can identify factors in groups and teams that inhibit performance. Competence level 6 „Create“: • Students can draw up recommendations to improve personal skills, collaboration, leadership and performance in teams and organizations in an international context.

Course content:	**Individual competence** • Personality and its implications for the working environment • Motivation, self-management and optimization of performance in an international context **Social skills** • Communication and collaboration in international companies • Intercultural teamwork and team development • Leadership styles in an international context • Change management in an international context **Functional expertise** • Recruiting, evaluating and professionally developing personnel in an international context
Assessment method:	Module work The Module Work comprises around 15-25 pages of individually written course work, based on the reflective questions raised in the seminars. The aim is to apply the course content in a practice-oriented manner. Further details to be given by the lecturer in the first seminar.
Literature/ Recommended reading:	ROBBINS, Stephen P. and Timothy A. JUDGE, 2017. *Organizational Behavior*. 17th edition. London. Pearson. ISBN: 13:978-1-292-14630 0 PUNNETT, Betty Jane. International perspectives on organizational behavior and human resource management. Routledge, 4th edition, 2018, ebook: ISBN 9781351019545.

4 Regulations for the courses during the internship semester

The courses during the Internship take place on Monday.

5 Proof of performance and examination duration

Compulsory attendance may only be ordered in laboratories with increased safety requirements (e.g. production technology laboratory). Compulsory attendance is deemed to have been fulfilled if at least 75% of the dates have been attended.

The performance records and examination durations can be found in the module descriptions.

6 Regulations for the practical semester

General regulations regarding the practical semester can be found in § 13 II of the Framework Examination Regulations, (Rahmenprüfungsordnung RaPo https://hm.edu/studium_1/im_studium/mein_studium/recht/spo.de.html), § 13 II and III of the General Examination Regulations of Munich University of Applied Sciences (Allgemeine Prüfungsordnung der Hochschule München https://hm.edu/studium_1/im_studium/mein_studium/recht/spo.de.html, and in the regulations on the implementation of practical semesters at state universities of applied sciences in Bavaria(available https://www.gesetze-bayern.de/Content/Document/BayVV_2210_4_1_WK_13582/true).

The internship should be completed in an industrial company at the interface of technology and business administration.
At the end of the practical semester, an internship report must be submitted and a colloquium must be held.

The internship report must be at least 10 pages long without illustrations (margins 2.5 cm, font size 12 point) and describe the activities that the student performed during the internship.
The experience gained during the internship is reviewed in the colloquium.
Full or partial crediting of practical work experience towards the practical periods in the internship semester is only possible in exceptional cases; the decisive factor is proof of the link between the previous professional activity and the course content.
The decision lies with the internship coordinator Prof. Dr. Brombach.