Module manual for
Textile Engineering
MSTexE

SPO Version 2019
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Module manual for Textile Engineering (Master (1-Subject))

RWTH AACHEN UNIVERSITY

Examination Regulation Field

Module offer

Examination offer

Teaching offer

CONTENT
Module manual for
Textile Engineering
MSTexE

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CONTENT
Module manual for
Textile Engineering
MSTexE

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Examination Regulation Title & Version:
Textile Engineering (SPO Version / 2019)

Title	Textile Engineering
Short title	MSTexE
Version	2019
Study/Qualification Objectives	The master's degree program in Textile Engineering qualifies graduates to develop processes and procedures for the production of fibers, yarns, and textiles of all kinds, as well as the design and construction of textile machines, and the simulation of textile structures, machines, and processes. The textile engineering technology has an international focus. Graduates who have obtained this master's degree possess the following qualifications: • They are qualified to work in a wide variety of fields and industries worldwide. To this end, the knowledge acquired in the bachelor's degree program is broadened and deepened in such a way that graduates are able to deal with complex issues and to carry out independent scientific work as well as to assess and develop solutions to problems. This includes material and product development, especially of marketable innovative textile structures, the development of testing and measuring methods, process analyses as well as the development of new technologies. • Furthermore, they have acquired knowledge in the development of textile machinery, new methods, and production processes along the entire value chain as well as the production and processing of natural and man-made fibers. They have also dealt with the production of technical textiles, e.g., for use in composite materials. • If they choose the specialization "Research", they are qualified to carry out complex experimental methods and also to carry out in-depth empirical work to solve interdisciplinary problems and, in particular, to carry out independent scientific work in the subject. After completing the specialization "Research", they have proven methodological competencies that prepare them for further scientific qualification, for example in research and development. • By choosing the "Coursework" specialization, they are prepared for professional employment in the textile engineering industry. For this purpose, industry-specific subject content, methodological knowledge, and approaches were taught. They have specialized knowledge of the practical application areas of textile mechanical engineering based on the latest scientific findings. In addition, they develop the understanding to critically evaluate developments in the field. This allows them to further develop their professional field of activity. • Furthermore, they possess interdisciplinary and social skills. Complementary to their professional knowledge, they have learned to appreciate other cultures and people and have been enabled to work in a team and to be strong in implementation.
Qualification Profile	
Additionnal information	

+ Linear Control Systems (4011476)

Module titel	Linear Control Systems (Compulsory subject)
Identifier	4011476
Version	Angelegt über RWTH API als 1_neu
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	Significance of control theory, examples of biological and biomedical control loops, functional diagrams, linearization, set up and solving of differential equations, stability, features in time domain of dynamical systems, Laplace transform, transfer function, frequency response, functional diagram algebra, features in frequency domain of dynamical systems, bode diagram, Nyquist plot, Linear control loop elements, principle and goals of controller design, algebraic stability criteria, steady state analysis and transient performance of a control loop, controller setting rules, Nyquist stability criterion, phase margin, gain margin, controller design in bode diagram.
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: Knowledge / Understanding: • know, recognize and classify the most common linear control loop elements • the effects of feedback and apply different methods to set up feedback elements (controllers) such that predefined control goals are met Abilities / Skills: • to analyze dynamical, biological and biomedical systems and identify the relevant causalities • to employ different mathematical descriptions of dynamical systems • solve differential equations by means of Laplace transform • assess of the stability of dynamical systems using different methods • obtain, interpret and employ the frequency response of dynamical systems
(Study-Specific) Prerequisites	-
(recommended) Requirements	Basic knowledge in mathematics as defined in the examination regulations.
References	-
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation • Written Exam (schriftliche Prüfung) or • Oral Exam (mündliche Prüfung)
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Dirk Abel
ECTS Credits	4
Contact time (WSH)	2

+ Linear Control Systems (4011476)

Examination duration (min)	-
Total hours (h)	120,0
Contact hours (h)	30,0
Self-study hours (h)	90,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Linear Control Systems (401147601)	1st semester	no semester recommended	4	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Linear Control Systems	1st semester	no semester recommended	-	1
Tutorial Linear Control Systems	1st semester	no semester recommended	-	1

+ High Performance Fibres (4011478)

Module titel	High Performance Fibres (Compulsory subject)
Identifier	4011478
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Summer semester 2015
Valid until	-
Module level	Master
Content	• definitions, classification and symbols of high performance fibres (hpf), markets and trends • characteristic temperatures, cristallisation,orientation • characteristic fibre properties (dullness, fineness, cross-section, length, degree of draft, crimp, yarn structure, stress-strain behaviour, thermal properties, dying etc.) • typical products made from hpf (staple fibres, textile and technical filament yarns, bicomponent fibres) • production technology of hpf • polymerisation, polycondensation, polyaddition (principle, reaction speed and throughput, molecular weight distribution) • reactor (function, types) • processing steps for the production of filament and staple fibre yarns • fundamentals of spinning: yarn formation (Law of Hagen-Poiseuille, spinnability, fibre cross-sections) • spinning systems for filaments and for staple fibres (oiling, drafting systems, crimp processes and machines, devices) • drafting: structural model, processes and machines • after-treatment processes • new fibre spinning processes
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: Knowledge / Understanding: The students: • have an overview about all important chemical fibres, the resp. processes, machines and devices with economical or technological importance. Competencies: The students... • explain the methods by which the fibre materials are synthesised, which devices and machines are needed therefore and can explain which are the advantages and disadvantages or the resp. technologies. • explain the chemical composition of the fibre materials and derive their major physical and chemical properties from it. They can explain for which application the fibres are suited and for what reasons. • select and assess suitable processes for new fibre materials. • analyse new processes for the production or processing of chemical fibres and assess them with regard to technological feasibility and economic impact. • design chemical fibre production plants, calculate their layout, e.g. throughput, efficiency depending on number-of-ends-down etc. • assess the economic feasibility of new spinning processes.
(Study-Specific) Prerequisites	Recommended Basic knowledge in polymer science
(recommended) Requirements	Basic knowledge in polymer science
References	-

+ High Performance Fibres (4011478)

Language	English
Examination Terms	The module grading is weighted according to the CP-allocation • Written Exam (schriftliche Prüfung) or • Oral Exam. (mündliche Prüfung)
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam High Performance Fibres (401147801)	2nd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture High Performance Fibres	2nd semester	no semester recommended	-	2
Exercise High Performance Fibres	2nd semester	no semester recommended	-	2

+ Fluid Dynamics (4011479)

Module titel	Fluid Dynamics (Compulsory subject)
Identifier	4011479
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Summer semester 2015
Valid until	-
Module level	Master
Content	• Fundamental Equations of Fluids • The objective is to understand the conservation laws of mass, momentum and energy which describe the flow of a continuum mechanics (gas, liquid) • Hydrostatics • Derivation of the equation of hydrostatics and application of different examples • Continuity Equation and Bernoulli Equation • Derivation of the continuity and mechanical energy conservation equations on the • streamline plus applications. • Momentum Equation • Derivation and application of the momentum equation • The student will be able to transfer the basic calculation procedures to related topics • Laminar Viscous Flows • Viscosity, viscous flows, steady flows between parallel plates, coquette flows, steady flows in pipes are discussed; Students are able to understand complete • Pipe systems • Turbulent Pipe Flow • Turbulent shear stresses, friction and drag are discussed. Students understand the difference between • laminar and turbulent flows • Dynamic Similarity • The Buckingham Pi Theorem is presented and similarity laws are derived and applied • to industrial problems • Irrotational Flow • The Laplace Equation is derived and the singularity solutions are discussed and applied to blunt body problems • Boundary Layer Theory • Laminar and turbulent boundary layers are discussed and its application to industrial problems is presented • Compressible Flows • Speed of sound, Hugoniot equation and normal and oblique shock relations are derived and related topics of supersonic flows in nozzles are discussed.
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: Knowledge and Understanding: Students… • understand the equations in fluid dynamics • understanding of fluid mechanics, including concepts of mass and momentum conservation laws, explicated theoretically as well as with practical examples. Abilities / Skills: Students… • are able to demonstrate and explain themethods of calculation Competencies: Students… • develop problem solving skills by applying mathematics and concepts for fluid flow analysis
(Study-Specific) Prerequisites	-

+ Fluid Dynamics (4011479)

(recommended) Requirements	-none-
References	Lecture Notes Students also receive a list of relevant literature
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation Written or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Wolfgang Schröder
ECTS Credits	5
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	60,0
Self-study hours (h)	90,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Fluid Dynamics (401147901)	1st semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture: Fluid Dynamics	1st semester	no semester recommended	-	2
Exercise Fluid Dynamics	1st semester	no semester recommended	-	2

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+ Composites (4011480)

Module titel	Composites (Compulsory subject)
Identifier	4011480
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Summer semester 2015
Valid until	-
Module level	Master
Content	Fibre materials for compositesFabrics and polymeric matrix materialsWoven fabricsNon crimp fabrics Braiding technologies3D structures for compositesTailored fibre placementPreforming and prepregging processes and endeffector technologiesTextile testing methods for composite structures
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: Competencies: The students… • select a suitable material for a composite application from a wide range and explain the advantages and disadvantages over other materials • assess which type of fabric is best suited for a certain application • explain in detail all processes for the production of textiles for composites • explain in detail preforming and prepregging processes • select a suitable testing method for composites depending on the application and explain the reasons for it • determine the necessary properties for material, textile structure and process for a new composite application
(Study-Specific) Prerequisites	Recommended Basic knowledge in textile materials and processing
(recommended) Requirements	Basic knowledge in textile materials and processing
References	-
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation Written exam or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

+ Composites (4011480)

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Composites (401148001)	2nd semester	no semester recommended	6	0

Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Composites	2nd semester	no semester recommended	-	2
Exercise Composites	2nd semester	no semester recommended	-	2

+ Machine Design Process (4012285)

Module titel	Machine Design Process (Compulsory subject)
Identifier	4012285
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2014
Valid until	-
Module level	Master
Content	Topic: Introduction Topic: Drawing Standards I • Projection drawing and axonometric views • Elements of technical drawings • Dimensioning Topic: Drawing Standards II • Section views • Broken views Topic: Joins and Connections • Connection types • Bolted connections • Shaft and hub connections Topic:Geometrical Irregularities and Tolerances • Dimension tolerances • Form and position tolerances • Technical surfaces Topic: Bearing of Shafts • Bearing principles • Bearing arrangements • Seals Topic: Power Transmission • Definitions and principles • Technical representation • Examples Topic: Engineering Design Process, Requirements List • Introduction to design methodology • General process of engineering design • Requirements list Topic: Conceptual Design I • Function structures and principle solutions • Design catalogues • Heuristic and analogy methods Topic: Conceptual Design II • Systematic variation, classification schemes • Overall solutions: morphological matrix Topic: Design Rules I - Basic Rules • Introduction to design rules • Basic rules “simple” and “clear” • Basic rule “safe” Topic: Design Rules II - Principles • Principles of fault-free design, force transmission, stability and bi-stability, self-help, division of tasks

+ Machine Design Process (4012285)

	Topic: Design Rules III - Guidelines / DFX • Selected examples: design for assembly and production…
Learning Objectives/ Learning Outcomes	The studens • know the most common machine elements and applicable design rules. They are able to draft such solutions according to ISO drawing standards and understand production drawings including dimensions and tolerances. • know structured problem solving strategies, esp. the engineering design process acc. to VDI 2221. They are able to identify possible restrictions on a design task and to develop and select applicable concept solutions with a systematic approach. • know the body of design rules and are able to determine applicability depending on effective design restrictions. Basic rules of embodiment design, design principles and guidelines can be applied to draw up technical drafts.
(Study-Specific) Prerequisites	-
(recommended) Requirements	none
References	Pahl, G.;Beitz, W.; Feldhusen, J.; Grote, K. H.: Engineering Design - A Systematic Approach, Third Edition. Springer, 2007.
Language	English
Examination Terms	Written or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Georg Jacobs
ECTS Credits	5
Contact time (WSH)	5
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	75,0
Self-study hours (h)	75,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Machine Design Process (401228501)	1st semester	no semester recommended	5	0

+ Machine Design Process (4012285)

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Vorlesung Machine Design Process	1st semester	no semester recommended	-	2
Übung Machine Design Process	1st semester	no semester recommended	-	3

+ Language Course I (4021266)

Module titel	Language Course I (Compulsory subject)
Identifier	4021266
Version	V1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2019
Valid until	-
Module level	Master
Content	The course is aimed at students who are looking for a university-specific foreign lan-guage education, who need a foreign language for their studies and/or are planning a stay abroad (study, internship, project). Depending on the level, the range of foreign languages on offer takes into account the training of language skills specific to the profession. In the course you will learn the essential elements of grammar and vocabulary of the respective language, depending on your level, so that you can assert yourself both in writing and orally in everyday communication situations. In addition, you will learn to extract the essential information from authentic and university-specific reading and lis-tening texts as well as from various types of texts such as: Write e-mails, letters, messages and notes.
Learning Objectives/ Learning Outcomes	To learn the basics of the respective language or to deepen and expand already existing skills for active participation in everyday and working life.
(Study-Specific) Prerequisites	-
(recommended) Requirements	none
References	-
Language	German/English
Examination Terms	100% written examination in reading, listening, writing and grammar
Miscellaneous	-
Module coordinator	-
ECTS Credits	2
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	60,0
Contact hours (h)	60,0
Self-study hours (h)	,0

+ Language Course I (4021266)

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Examination Language Course I (402126601)	1st semester	no semester recommended	2	-

Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Language Course I	1st semester	no semester recommended	-	2
Exercise Language Course I	1st semester	no semester recommended	-	2

+ Language Course II (4021267)

Module titel	Language Course II (Compulsory subject)
Identifier	4021267
Version	V1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2019
Valid until	-
Module level	Master
Content	The course is aimed at students who are looking for a university-specific foreign lan-guage education, who need a foreign language for their studies and/or are planning a stay abroad (study, internship, project). Depending on the level, the range of foreign languages on offer takes into account the training of language skills specific to the profession. In the course you will learn the essential elements of grammar and vocabulary of the respective language, depending on your level, so that you can assert yourself both in writing and orally in everyday communication situations. In addition, you will learn to extract the essential information from authentic and university-specific reading and lis-tening texts as well as from various types of texts such as: Write e-mails, letters, messages and notes.
Learning Objectives/ Learning Outcomes	To learn the basics of the respective language or to deepen and expand already existing skills for active participation in everyday and working life.
(Study-Specific) Prerequisites	-
(recommended) Requirements	none
References	-
Language	German/English
Examination Terms	100% written examination in reading, listening, writing and grammar
Miscellaneous	-
Module coordinator	-
ECTS Credits	2
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	60,0
Contact hours (h)	60,0
Self-study hours (h)	,0

+ Language Course II (4021267)

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Examination Language Course II (402126701)	2nd semester	no semester recommended	2	-

Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Language Course II	2nd semester	no semester recommended	-	2
Exercise Language Course II	2nd semester	no semester recommended	-	2

+ Language Course III (4021268)

Module titel	Language Course III (Compulsory subject)
Identifier	4021268
Version	V1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2019
Valid until	-
Module level	Master
Content	The course is aimed at students who are looking for a university-specific foreign lan-guage education, who need a foreign language for their studies and/or are planning a stay abroad (study, internship, project). Depending on the level, the range of foreign languages on offer takes into account the training of language skills specific to the profession. In the course you will learn the essential elements of grammar and vocabulary of the respective language, depending on your level, so that you can assert yourself both in writing and orally in everyday communication situations. In addition, you will learn to extract the essential information from authentic and university-specific reading and lis-tening texts as well as from various types of texts such as: Write e-mails, letters, messages and notes.
Learning Objectives/ Learning Outcomes	To learn the basics of the respective language or to deepen and expand already existing skills for active participation in everyday and working life.
(Study-Specific) Prerequisites	-
(recommended) Requirements	none
References	-
Language	German/English
Examination Terms	100% written examination in reading, listening, writing and grammar
Miscellaneous	-
Module coordinator	-
ECTS Credits	2
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	60,0
Contact hours (h)	60,0
Self-study hours (h)	,0

+ Language Course III (4021268)

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Examination Language Course III (402126801)	3rd semester	no semester recommended	2	-

Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Language Course III	3rd semester	no semester recommended	-	2
Examination Language Course III	3rd semester	no semester recommended	-	2

Module titel	Advanced Finite Element Methods for Engineers (Compulsory subject)
Identifier	4013866
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	Content • General introduction, concept of the finite element method • Symbolic assembly procedure • Global and local coordinates • Stiffness matrix for trusses / coordinate transformation • Variational techniques • Solution of truss structures • Variational techniques, Euler-Lagrange equation • Natural and forced boundary conditions • Multiple integrals, Gauss-Theorem • Variations of elementary algebraic functions • Variational principle for linear self-adjoint diff. operators • Solution of some classical variational problems • Principle of virtual work as a weak form of the momentum balance, variational principles of mechanics (Lagrange, Hu-Washizu) • Differential equation of a linear elastic bar, analytic solution for various load cases • Rayleigh-Ritz method, weighted residual approximations, Point or subdomain collocation • Galerkin method, least-squares method, linear elastic bar approximated by a continuous shape function • Displacement formulation • Three-field (mixed) formulation • Examples to weighted residual approximations • Requirements to shape functions • Continuous shape functions, piecewise defined shape functions, approximation by piecewise defined shape functions. • 2-d problems of elasticity, triangular element, plain strain and plane stress problems, • Torsion of a prismatical bar • Examples for plain strain and plane stress problems discretized by linear triangular elements

	• Axisymmetric stress analysis, 3-d stress analysis • Construction of 2-d and 3-d finite elements (Lagrange and serendipity family) • Concept of hierarchical shape functions • Concept of mapping in iso-parametric finite elements • Application of numerical integration in 1-d, 2-d and 3-d finite element problems • Non-linear finite element problems (Newton-Raphson method) • Dynamic (time-dependent) finite element problems, time step size and mass scaling
Learning Objectives/ Learning Outcomes	The aim of the course is to impart the basic knowledge about finite element methods and their application to solid and structural mechanics. The students will • understand why the FE-Method and the other numerical methods behind are important for engineering practice • understand the basic concept of FEM • be able to find solutions for trusses with a variety of boundary conditions • understand the fundamental concept of variational calculus • be able to find solutions for mechanical problems by using weighted residual methods • be able to use finite element method for plane strain, plane stress and torsion problems • be able to construct finite elements with linear and non-linear shape functions • understand the application of numerical integration in finite element method • understand the concept of non-linear and time-dependent finite element problems In addition, voluntary programming exercise sessions are offered to deepen the theoretical understanding. A simple FEM solver is developed in Python, numerical integration schemes are discussed and the FEniCS programming package is introduced.
(Study-Specific) Prerequisites	-
(recommended) Requirements	-
References	-
Language	English
Examination Terms	Written exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. (RUS) Mikhail Itskov
ECTS Credits	5
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	60,0
Self-study hours (h)	90,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Advanced Finite Element Methods for Engineers (401386601)	1st semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Advanced Finite Element Methods for Engineers	1st semester	no semester recommended	-	2
Tutorial Advanced Finite Element Methods for Engineers	1st semester	no semester recommended	-	2

Module titel	Minor Research Project (Compulsory subject)
Identifier	4014345
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Basics of project management • Basics of time planning • Planning experiments with factorial design • Evaluation of results with statistical methods • Oral and written presentation of results • Actual project work on a subject chosen by student from a wide range of topics offered at ITA
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: **Knowledge / Understanding** The students… • know how to plan a research project • know how to design experiments to get a maximum output (effects and interactions of the parameters on the result) • know how to evaluate the results using advanced statistical methods **Abilities / Skills** The students… • learn to work independently on a scientific topic **Competencies** The students... • analyse the problem at-hand • determine possible ways to solve it, explain the best way to do so by comparing and assessing the given possibilities • apply the chosen way to solve the problem • document every step of the project • learn how to present their results oral and written
(Study-Specific) Prerequisites	-
(recommended) Requirements	none
References	-
Language	English
Examination Terms	The module grading is weighted according to the CP allocation Report (80 %) and oral presentation (20 %) (Bericht (80%) und mündliche Präsentation (20%))
Miscellaneous	-
Module coordinator	-
ECTS Credits	7
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	210,0

Contact hours (h)	60,0
Self-study hours (h)	150,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Examination: Minor Research Project (401434501)	1st semester	no semester recommended	7	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture: Minor Research Project	1st semester	no semester recommended	-	2
Exercise: Minor Research Project	1st semester	no semester recommended	-	2

Module titel	Gear and Transmission Technology (Compulsory subject)
Identifier	4011427
Version	V2
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2019
Valid until	-
Module level	-
Content	L01: Transmission in application L02: Gear geometry L03: Gear damages L04: Gear design I - Macro geometry L05: Gear design II - Micro geometry L06: Load Carrying and Efficiency L07: Acoustics L08: Process chains L09: Manufacturing I - Defined cutting edge L10: Manufacturing II - Undefined cutting edge L11: Crossing axes I - Bevel gears L12: Crossing axes II - Special gears L13: Planetary gears
Learning Objectives/ Learning Outcomes	L01: Transmission in application L02: Gear geometry L03: Gear damages L04: Gear design I - Macro geometry L05: Gear design II - Micro geometry L06: Load Carrying and Efficiency L07: Acoustics L08: Process chains L09: Manufacturing I - Defined cutting edge L10: Manufacturing II - Undefined cutting edge L11: Crossing axes I - Bevel gears L12: Crossing axes II - Special gears L13: Planetary gears
(Study-Specific) Prerequisites	-
(recommended) Requirements	Manufacturing Technology I Machine Tools
References	Lecture and exercise notes for download Recommended literature: • Zahnrad- und Getriebetechnik, Fritz Klocke, Christian Brecher • Werkzeugmaschinen Bd. 1, Christian Brecher • Fertigungstechnik Bd. 1-5, Fritz Klocke
Language	English
Examination Terms	Eine schriftliche oder eine mündliche Prüfung
Miscellaneous	-

– Focus on Coursework
– Compulsory Courses Focus on Coursework
+ Gear and Transmission Technology (4011427)

Module coordinator	Universitätsprofessor Dr.-Ing. Christian Brecher Universitätsprofessor Dr.-Ing. Dr.-Ing. E. h. Dr. h. c. Dr. h. c. Fritz Klocke
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Gear and Transmission Technology (401142701)	2nd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise Gear and Transmission Technology	2nd semester	no semester recommended	-	2
Lecture Gear and Transmission Technology	2nd semester	no semester recommended	-	2

Module titel	Fibre Science I (Compulsory elective subject)
Identifier	4010859
Version	-
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Bachelor/Master

Content	1
	• Fundamentals of fibres:
	  • Definition, classification, symbols
	  • Markets and trends
	2
	• Cotton 1:
	  • History, cultivation, growth, varieties
	  • Composition, structure
	3
	• Cotton 2:
	  • Properties, classifiction, producing countries, production
	  • Harvest, ginning
	4
	• Cotton 3:
	  • Pests, genetic engineering
	  • Trade (exchange, routes)
	5
	• Bast fibres 1:
	  • Flax (history, cultivation, growth, varieties, fibre production, composition, properties, classification, applications, production, trade)
	6
	• Bast fibers 2:
	  • Hemp (history, cultivation, varieties, fibre prodcution, compositoin, properties, applications, production, trade)
	  • Jute, ramie, kenaf, other bast fibres
	7
	• Hard and fruit fibres:
	  • Agave (cultivation, fibre production, properties, applicatoins)
	  • Musa, cocos, grass, plam, kapok and other fibres
	8
	• Wool 1:
	  • Hitory, terms, sheep breeds and sheep breeding, fiber production
	9
	• Wool 2:
	  • Composition, properties, classification, applications, trade
	  • Further processing
	10
	• Fine animal hair:
	  • Camel, goat, rabbit, yak (fibre production, composition, properties, applications, trade)
	  • Comparison of important fine animal hairs

	11
	• Silk 1:
	  • Mulberry silk (history, terms and definitions, breeding, classification, fibre production, composition, properties, classification)
	12
	• Silk 2:
	  • Mulberry silk (production, trade, yarn production, finishing, applications)
	  • Tussah silk (fibre production, properties, appications)
	  • Spider silk (fibre production, properties)
	  • Other silks
	13
	• Asbestos:
	  • History, terms and definitions, formation, deposits, fibre production, composition, properties, classification, processing applications, production
	  • Health hazards, renovation of asbestos contaminated buildings, replacement materials
	14
	• Cellulosic fibres 1:
	  • History, basic materials, pulp production
	  • Regenerated fibres (viscose, modified viscose; chemical basics, processes, machines and devices)
	15
	• Cellulosic fibres 2:
	  • Regenerated fibres (cupro, lyocell; chemical basics, processes, machines and devices)
	  • Derivative fibres (acetate, nitrocellulose; chemical basics, processes, machines and devices)

Learning Objectives/ Learning Outcomes	With respect to the subject: • The students have an overview about all natural fibres with economical or technological relevance. They can explain, why the market shares of the fibre materials have shifted over time due to changes in technology, society and fashion. • They can explain the production processes of all important natural fibres and name advantages and disadvantages of the resp. processes and technologies. • They can select suitable processes for new fibre materials. • They know the important properties of natural fibres and the resp. applications and products and they can explain why certain fibre materials are qualified for certain applications. • They can describe the trade process of the important natural fibres and discuss and explain the influence of external boundary conditions (e.g. subsidies) on price and market share. • The students can explain the basic principles of genetically engineered cotton and assess risks and gains of these processes. • The students can explain, analyse and compare the principles and processes for the production of cellulosic fibres. They can derive which process is best depending on material and the desired fibre properties.
(Study-Specific) Prerequisites	-
(recommended) Requirements	Reccommended Requirements (e.g.. other Modules, foreign languages, …): • Textile Technology 1
References	• Vorlesungsumdruck Faserstoffe 1 (erhältlich am ITA), 360 Seiten, zahlreiche Abbildungen • Literaturliste im Vorlesungsumdruck • Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine schriftliche Klausur
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries

ECTS Credits	3
Contact time (WSH)	2
Examination duration (min)	-
Total hours (h)	90,0
Contact hours (h)	30,0
Self-study hours (h)	60,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Fibre Science I (401085901)	3rd semester	no semester recommended	3	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Fibre Science I	3rd semester	no semester recommended	-	2

Module titel	Textile Technology III (Compulsory elective subject)
Identifier	4014290
Version	-
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1 • Überblick über die Weberei: • Wichtige Erfindungen, Einsatzgebiete • Webereivorbereitung 1: • Überblick über die Verfahren, Spulengatter 2 • Webereivorbereitung 2: • Weben vom Gatter, Direktbäumen • Zetteln, Schären • Schlichten, Mittel und Verfahren, Trocknung, Energieeinsparung, Trends 3 • Aufbau und Funktion von Webmaschinen: • Fachbildung, Schusseintrag, weitere Einrichtungen • Fachbildung 1: • Fachgeometrie, Fachbildemechanismen • Exzentermaschinen, Prinzip, Aufbau, Typen 4 • Fachbildung 2: • Schaftmaschinen, Prinzip, Aufbau, Typen • Jacquardmaschinen, Prinzip, Aufbau, Typen 5 • Kettablass: • Einteilung, mechanische und elektronische Systeme • Streichbaum 6 • Schusseintragsverfahren 1: • Überblick • Schützenwebmaschinen, Prinzip, Aufbau • Projektilwebmaschinen, Prinzip, Aufbau • Greiferwebmaschinen, Prinzip, Aufbau, Typen (Band-, Stangengreifer) 7 • Schusseintragsverfahren 2: • Düsenwebmaschinen, Prinzip, Aufbau, Typen (Luft, Wasser) • Düsengeometrien, Ansteuerung • Sonderwebverfahren: • Mehrphasen, Reihenfach, Rundweben, Bandweben, Teppichweben 8 • Zusatzaggregate: • Ketteinzug, Kettwächter, Schussfadenspeicher, Schussfadenbremsen • Schussfadenwächter, Kantenbildung, Kantenschere, Breithalter 9

	• Markt: • Webmaschinenhersteller, Marktentwicklung in Asien und Europa, Trends • Bindungslehre: • Definitionen, Grundbindungen, Kurzzeichen, erweiterte und verstärkte Bindungen 10 • Maschenwarenherstellung: • Grundlagen, Maschenbildung, Bindungsgruppen, Bindungselemente, Musterungsmöglichkeiten, 11 • Strickmaschinen: • Flachstrickmaschinen, Maschenbildung, RR-, RL-, LL-Maschinen • Rundstrickmaschinen, Maschenbildung, RR-, RL-, LL-Maschinen • Fadenlaufdarstellung, Musterungsmöglichkeiten, Zusatzaggregate 12 • Wirkmaschinen: • Cottonmaschine, Prinzip, Maschenbildung • Kettenwirkmaschinen, Prinzip, Maschenbildung, Musterungsmöglichkeiten • Raschelmaschinen, Häkelgalonmaschinen, Prinzip, Musterungsmöglichkeiten • Wirkmaschinen für multiaxiale Gelege, Prozesse 13 • Veredlungsmaschinen 1: • Farblehren, Färbe- und Druckapparate • Mechanische Verdelungsverfahren, Prinzipien, Maschinen 14 • Veredlungsmaschinen 2: • Nassveredlungsverfahren, Prinzipien, Maschinen • Trocknungsprinzipien, Maschinen 15 • Antriebstechnik in Textilmaschinen: • Einzel- und Gruppenantriebe • Wirtschaftliche Betrachtung, Anwendungsbeispiele
Learning Objectives/ Learning Outcomes	Fachbezogen: • Die Studierenden können alle relevanten Verfahren und Maschinen der Webereivorbereitung, der Weberei, der Strickerei, der Wirkerei und der Veredlung erklären, gegenüber stellen, bewerten und kritisch vergleichen. • Die Studierenden besitzen umfassende Kenntnisse über die den einzelnen Prozessen zugrunde liegenden physikalischen Prinzipien. • Die Studierenden sind in der Lage, darauf aufbauend neue Web-, Maschenbildungsund Veredlungsverfahren zu analysieren und zu bewerten. • Die Studierenden können unterschiedliche Maschinenkonzepte bewerten und kritisch vergleichen. • Die Studierenden sind mit den heute üblichen Antriebs- und Steuerungs- bzw. Regelungskonzepten der entsprechenden Textilmaschinen vertraut, sie können sie erklären und beurteilen. • Die Studierenden können zu allen relevanten Maschinen Berechnungen zur Produktivität und Auslegung durchführen. • Die Studierenden sind in der Lage Bindungspatronen (Gewebe, Maschenwaren) zu zeichnen und zu analysieren. Die Lernziele werden erreicht durch die Vorstellung der beschriebenen Vorlesungsinhalte in den Vorlesungen sowie durch Rechenübungen und Vorführungen der relevanten Maschinen. Nicht fachbezogen (z.B. Teamarbeit, Präsentation, Projektmanagement, etc.): • Durch die praktischen Übungen an den Maschinen lernen die Studierenden, im Team Problemstellungen selbständig und unter Anleitung zu lösen.
(Study-Specific) Prerequisites	-
(recommended) Requirements	Empfohlene Voraussetzungen (z.B. andere Module, Fremdsprachenkenntnisse, …):

	• Textiltechnik I
References	• Vorlesungsumdruck (erhältlich am ITA), 350 Seiten, zahlreiche Abbildungen • Literaturliste im Anhang des Umdrucks • Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine schriftliche Klausur
Miscellaneous	-
Module coordinator	Modellierungsteamverantwortlicher: Philipp Friedl M. A. Modulverantwortlicher: Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Textile Technology III (401429001)	2nd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Vorlesung Textiltechnik III	2nd semester	no semester recommended	-	2
Übung Textiltechnik III	2nd semester	no semester recommended	-	2

Module titel	Selected Topics in Textile Technology (Compulsory elective subject)
Identifier	4015718
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	Recycling von Fasern, Garnen und TextilienSpezialtextilmaschinenFlockverfahrenSonderwebtechnikenSpezielle TextilveredlungsverfahrenBekleidungsfertigungTextiler Anlagenbau
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: **Knowledge / Understanding** Students • know relevant technological principles of the shown subjects and topics • know advantages and disadvantages of machines and processes and can explain advantages and disadvantages **Abilities / Skills** Students learn • how to apply their knowledge from a prior Bachelor degree to advanced problems and challenges of textile engineering **Competencies** Students • work in teams, independently and under supervision to solve given problems due to small-group practical exercises
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended • Textiltechnik I, II, III • Technische Textilien
References	Vorlesungsumdruck Literaturliste im L2P
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation Written Exam (schriftliche Prüfung) or Oral Exam. (mündliche Prüfung)
Miscellaneous	-
Module coordinator	Dr.-Ing. Dieter Veit Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0

Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Selected Topics in Textile Technology (401571801)	2nd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Exercise Selected Topics in Textile Technology	2nd semester	no semester recommended	-	4

Module titel	Technical Textiles (Compulsory elective subject)
Identifier	4012458
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Bachelor/Master
Content	1 • Einführung und Überblick: • Fasern und Textilien • Einsatzgebiete und Anwendungen • Märkte • Fertigungsstufen 2 • Rohstoffe 1: • Einteilung, Eigenschaften wichtiger Fasern, Kurzzeichen • Naturfasern: • Baumwolle (Sorten, Anbau, Ernte), Bast- und Hartfasern (Flachs, Hanf), • Wolle (Schafrassen, Gewinnung, Qualitäten) • Andere Naturfasern (feine Tierhaare, Seide, Asbest) 3 • Rohstoffe 2: • Synthetische Fasern: • Einteilung, Bildungsmechanismen, Strukturmodelle • Spinnprozesse (Schmelzspinnen, Lösungsspinnen) • Anlagentechnik • Polyester, Polyamid 4 • Rohstoffe 3: • Verarbeitung von Chemiefasern (Verstreckung, Texturierung, Spinnfaserherstellung, Konvertierung) • Glas (Aufbau, Spinnprozesse, Eigenschaften, Produkte) • Carbon (Aufbau, Spinnprozesse, Eigenschaften, Produkte) 5 • Spinnereivorbereitung 1: • Übersicht (Verfahren, wichtigste Prozessstufen) • Ernte und Entkörnung, Klassierung von Baumwollfasern • Ballenabarbeitung, Öffnung, Reinigung, Mischen (Prinzipien, Maschinen) 6 • Spinnereivorbereitung 2: • Karde (Funktion, Prinzip, Maschine, Komponenten) • Kämmen (Funktion, Prinzip, Maschine) 7 • Spinnverfahren 1: • Ringspinnen (Flyer, Ringspinnen - Prinzip, Maschine, Produkte) • Kompaktspinnen 8 • Spinnverfahren 2: • OE-Rotorspinnen (Prinzip, Maschine, Produkte) • OE-Friktionsspinnen (Prinzip, Maschine, Produkte)

• Luftspinnen (Luft-Falsch- und Luftechtdrahtverfahren)
• Vergleich der Spinnverfahren (Produktivität, Produkteigenschaften)

9
• Webereivorbereitung:
• Übersicht
• Spulen, Zwirnen
• Kettbaumherstellung (Zwirnen, Schären, Schlichten)

10
• Webmaschinen:
• Fachbildung (Prinzipien, Vor- und Nachteile, Maschinen, Einsatzgebiete)
• Schusseintragsverfahren (Prinzipien, Maschinen, Einsatzgebiete)
• Markt
• Gewebebindungen:
• Begriffe, Grundbindungen und Ableitungen

11
• Maschenwarenherstellung:
• Maschenbildeverfahren
• Nadeltypen
• Maschenbildende Maschinen (Strick- und Wirktechnik)
• Musterung, Einsatzgebiete, Markt

12
• Vliesstoffe:
• Rohstoffe
• Herstellungsverfahren (Prinzipien, Maschinen und Anlagen)
• Verfestigungsverfahren (Prinzipien, Maschinen)
• Einsatzgebiete, Markt

13
• Technische Textilien:
• Definitionen, Einteilung
• Anwendungsbeispiele
• Herstellungsverfahren (Prinzipien, Maschinen)

14
• Veredlung
• Vorbehandlung (Prinzipien, Maschinen und Aggregate)
• Hilfsprozesse (Prinzipien, Maschinen)
• Farbgebung (Farbmetrik, Farbstoffe, Färbeprinzipien, Färbeapparate)
• Appretur (Prinzipien, Maschinen)

15
• Konfektion:
• Markt
• Zuschnitt, Fügeverfahren (Prinzipien, Apparate)
• Recycling:
• Verfahren, Maschinen und Anlagen

Learning Objectives/ Learning Outcomes

- Die Studierenden besitzen einen Überblick über alle wichtigen Rohstoffe, Verfahren und Maschinen der Textilherstellung sowie über die entsprechenden Märkte.
- Sie können beschreiben, welche Rohstoffe zur Textilherstellung eingesetzt werden. Sie können erklären, wie die Fasern gewonnen bzw. erzeugt werden und welche besonderen Eigenschaften sie für die jeweiligen Anwendungsgebiete besonders geeignet machen.
- Die Studierenden können alle wichtigen Prinzipien, Prozesse und Maschinen bzw. Anlagen der Spinnereivorbereitung, der Garn-, Gewebe-, Maschenwaren- und Vliesstoffherstellung benennen, erläutern und ggf. bewerten.
- Sie können die Einteilung der Technischen Textilien sowie jeweils typische Anwendungsgebiete und Produkte benennen.
- Sie können die entsprechenden Werkstoffe und textilen Strukturen je nach Einsatzgebiet auswählen und bewerten.
- Sie können alle wichtigen Prozesse, Aggregate und Maschinen der Veredlung sowie der Konfektionierung beschreiben und erklären.
- Die Studierenden können die wichtigsten Verfahren des Recyclings darstellen und technologisch bzw. wirtschaftlich bewerten.

	• Die Studierenden sind in der Lage, einfache Rechnungen zur Auslegung der wichtigsten Maschinen der Textilherstellung auszuführen. Dazu gehören z. B. Berechnungen des Durchsatzes bei der Chemiefaserherstellung, die Fehlerortsbestimmung in Streckwerken, Berechnung der Produktivität von Flyer-, Ringspinn-, Rotorspinn- und Webmaschinen. • Die Studierenden haben in den praktischen Laborübungen gelernt, die wichtigsten Maschinen der Garn- und Gewebeherstellung zu bedienen. Die Lernziele werden erreicht durch die Vorstellung der beschriebenen Vorlesungsinhalte in den Vorlesungen sowie durch Rechenübungen und Vorführungen der relevanten Maschinen.
(Study-Specific) Prerequisites	-
(recommended) Requirements	keine
References	• Vorlesungsumdruck Textiltechnik I (erhältlich am ITA), 300 Seiten, zahlreiche Abbildungen • Literaturliste im Vorlesungsumdruck • Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine Klausur
Miscellaneous	-
Module coordinator	Modellierungsteamverantwortlicher: Philipp Friedl M. A. Modulverantwortlicher: Dr.-Ing. Dieter Veit Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Technical Textiles (401245801)	2nd semester	no semester recommended	6	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Übung Technische Textilien	2nd semester	no semester recommended	-	2
Vorlesung Technische Textilien	2nd semester	no semester recommended	-	2

Module titel	Fibre Science II (Compulsory elective subject)
Identifier	4013363
Version	-
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Bachelor/Master
Content	1 • Fundamentals of chemical fibres 1: • Definition, classification, symbols • Historical development • Market and trends, production, trade and consumption 2 • Fundamentals of chemical fibres 2: • Characteristic temperatures, cristallisation, orientation • Characteristic fibre properties (dullness, fineness, crosssection, length, degree of draft, crimp, yarn structure, stress-strain behaviour, thermal properties, dying) • Typical products made from chemical fibres (staple fibres, textile and technical filament yarns, carpet yarns, spunbonds, bicomponent fibres) 3 • Production of chemical fibres: Polymerisation, polycondensation, polyaddition (principle, reaction speed and throughput, molecular weight distribution) • Reacotr (function, types) • Pigmentation • Processing steps for the production of filament and staple fibre yarns 4 • Fundamentals of spinning: • Yarn formation (Law of Hagen-Poiseuille, spinnability, fibre cross-sections) • Important spinning processes (melt, dry and wet spinning) 5 • Common measures of all spinning processes: • Pipes, static mixers • Spin pumps, spinnerets • Quench duct, spinning preparation 6 • Melt spinning 1: • Polymer preparation (granulation, drying) • Melting and spinning (extruder, pipe flows, spinnerets, yarn formation, quench duct, through put) • Spinning systems (rectangular and round spinnerets) 7 • Melt spinning 2: • Spinning systems for staple fibres (oiling, drafting systems, crimp processes and machines, devices) • Textile filament yarns (POY, conventional, modified) 8 • Melt spinning 3: • Technical filament yarns (FDY, FOY) • Carpet filament yarns (BCF)

- Spunbonds
- Monofilaments

9

- Solution spinning:
- Dry spinning (spinning solution, yarn formation, processes)
- Wet spinning (spinning solution, yarn formation, processes)
- Air gap spinning
- Other spinning processes

10

- Drafting:
- Structural models, drafting spot, stress-strain curves
- Processes (godets, roller, DUOs)
- Drawspinning (principle, process, machine)
- Drawtwisting (principle, process, machine)
- Warp stretching (principle, process, machine)
- Sectional warping (prinpicle, machine)

11

- After-treatment:
- Washing, oiling
- Drying, fixation (filaments, cables, staple fibres), shrinkage
- Texturing processes
- Crimper, airjet texturing, false-twist processes

12

- Conversion of fibre cables:
- Cutting, tearing
- Bales:
- Bale pressing, winding
- Combination of processing steps (raw materials, spinning, fibre production, textile filaments, technical filaments, carpet yarns)
- Special testing processes for chemical fibres

13

- Polyester:
- History, synthesis, spinning processes, properties, products
- Direct spinning plants
- Markets, trends
- Special types (PBT, PTT)

14

- Polyamide:
- History, synthesis (PA 6, PA 6.6), spinning processes, properties, products
- Special types (PA 7, PA 6.10)
- Polyurethane (Elastane)

15

- Polyolefines:
- Polypropylene (synthesis, spinning processes, properties)
- Polyethylene (synthesis, spinning processes, properties)
- Polyacrylonitrile (synthesis, spinning processes, properties)

Learning Objectives/ Learning Outcomes

With respect to the subject:

- The students have an overview about all important chemical fibres, the resp. processes, machines and devices with economical or technological importance.
- They can explain, why the market shares of the fibre materials have shifted over time due to changes in technology, society and fashion.
- They can explain the methods by which the fibre materials are synthesised, which devices and machines are needed therefore and which are the advantages and disadvantages or the resp. technologies.
- They can explain the chemical composition of the fibre materials and derive their major physical and chemical properties from it. They can explain for which application the fibres are suited and for what reason.
- They can select and assess suitable processes for new fibre materials.
- The students can analyse new processes for the production or processing of chemical fibres and assess them with regard to technological feasibility and economical impact.

	• The students can design chemical fibre production plants, calculatute their layout, e.g. throughput, efficiency depending on number-of-end-down etc. • They can assess the economical feasibility of new spinning processes. • The students can run the most important machines for the production and the processing of chemical fibres. Not with respect to the subject (e.g. Team work, Presentation, Project Management, etc.): • The students have learned in a team to get a machine running for the processing of chemical fibres.
(Study-Specific) Prerequisites	-
(recommended) Requirements	Reccommended Requirements (e.g.. other Modules, foreign languages, …): • Textile Technology 1 • Fibre Science 1
References	• Vorlesungsumdruck Faserstoffe 2 (erhältlich am ITA), 250 Seiten, zahlreiche Abbildungen • Literaturliste im Vorlesungsumdruck • Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine schriftliche Klausur
Miscellaneous	-
Module coordinator	Modulangebotsorganisator: Thomas Fieder B. Sc.Modellierungsteamverantwortlicher: Philipp Friedl M. A.Modulverantworlicher: Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	3
Contact time (WSH)	2
Examination duration (min)	0
Total hours (h)	90,0
Contact hours (h)	30,0
Self-study hours (h)	60,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Fibre Science II (401336301)	2nd semester	no semester recommended	3	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Exercise Fibre Science II	2nd semester	no semester recommended	-	2

Module titel	Textile Technology II (Compulsory elective subject)
Identifier	4011484
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1 • Geschichte der Textilherstellung: • Altertum, Mittelalter, Produktionsverfahren, Handel • Industrialisierung, Produktionstechnik, soziale Entwicklung 2 • Prozesslinien in der Spinnerei: • Kurzstapelverfahren • Langstapelverfahren • Streichgarnverfahren und sonstige Prozesse 3 • Baumwollernte und -entkörnung: • Ernte, Entkörnung • Yield, Ballenpresse, Trends 4 • Öffnen, Reinigen, Mischen: • Prinzipien, Technologien • Maschinen 5 • Karde 1: • Garnituren, Flockenspeiser, Vorreißer • Tambour, Abnehmer, Bandbildung 6 • Karde 2: • Regel- und Steuersysteme, Antriebskonzepte • Absaugung, Trends 7 • Strecke: • Einlauf, Streckwerk, Vorverzug • Regulierung, Bandablage, Antriebe • Häkchentheorie, Mischstrecken, integrierte Strecken, Trends 8 • Kämmmaschine: • Kämmereivorbereitung • Kämmmaschinen, Linien • Trends 9 • Flyer: • Aufbau und Funktion, Streckwerk, Flügel • Aufwicklung, Doffen • Antriebe, Automatisierung, Trends

	10 • Ringspinnen: • Prinzip, Streckwerk, Ring-Läufer-Systeme, Maschinen • Theoretische Grundlagen, Trends 11 • Kompaktspinnen: • Prinzip, Streckwerke, Trends • Direktspinnen: • Prinzip, Streckwerk, Maschinen 12 • Spulen: • Begriffe, Wicklungsarten, Changierverfahren • Qualitätssicherung, Spulenformen, Spulmaschinen, Trends 13 • OE-Rotorspinnen: • Prinzip, Aggregate, Maschinen • Theoretische Betrachtungen, Falschdraht, Trends 14 • Luftspinnen: • Prinzipien, Maschinen • Trends 15 • Sonstige Spinnverfahren: • Überblick über nicht-konventionelle Spinnverfahren, • z.B. Topfspinnen, Self-Twist, Adhäsionsverfahren, Bobtex
Learning Objectives/ Learning Outcomes	Fachbezogen: • Die Studierenden können alle relevanten Verfahren und Maschinen der Spinnereivorbereitung und der Spinnerei erklären, gegenüber stellen, bewerten und kritisch vergleichen. • Die Studierenden besitzen umfassende Kenntnisse über die den einzelnen Prozessen zugrunde liegenden physikalischen Prinzipien. • Die Studierenden sind in der Lage, darauf aufbauend neue Spinnverfahren zu analysieren und zu bewerten. • Die Studierenden können unterschiedliche Maschinenkonzepte bewerten und kritisch vergleichen. • Die Studierenden sind mit den heute üblichen Antriebs- und Steuerungs- bzw. Regelungskonzepten der entsprechenden Textilmaschinen vertraut, sie können sie erklären und beurteilen. • Die Studierenden haben alle am ITA vorhandenen und in den Übungen behandelten Spinnereivorbereitungsmaschinen und Spinnmaschinen bedient und sind so mit den wichtigsten Einstellungskriterien vertraut. • Die Studierenden können zu allen relevanten Maschinen Berechnungen zur Produktivität und Auslegung durchführen. Die Lernziele werden erreicht durch die Vorstellung der beschriebenen Vorlesungsinhalte in den Vorlesungen sowie durch Rechenübungen und Vorführungen der relevanten Maschinen. Nicht fachbezogen (z.B. Teamarbeit, Präsentation, Projektmanagement, etc.): • Durch die praktischen Übungen an den Maschinen lernen die Studierenden, im Team Problemstellungen selbständig und unter Anleitung zu lösen.
(Study-Specific) Prerequisites	-
(recommended) Requirements	Empfohlene Voraussetzungen (z.B. andere Module, Fremdsprachenkenntnisse, …): • Textiltechnik I
References	• Vorlesungsumdruck (erhältlich am ITA), 320 Seiten, zahlreiche Abbildungen • Literaturliste im Anhang des Umdrucks

	• Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine Klausur
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Textile Technology II (401148401)	3rd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Übung Textiltechnik II	3rd semester	no semester recommended	-	2
Vorlesung Textiltechnik II	3rd semester	no semester recommended	-	2

Module titel	Modeling and Simulation in Textile Engineering (Compulsory elective subject)
Identifier	4011485
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Factorial design • Basics of simulation, modeling and soft computing • Neural networks (principles, algorithms, applications) • Genetic algorithms and evolution strategy (principles, applications) • Fuzzy logic (principles, algorithms, applications) • Computational fluid dynamics (principles, algorithms, applications) • Digital image processing (principles, algorithms, applications)
Learning Objectives/ Learning Outcomes	After successfully completing this course, the students will have acquired the following learning outcomes: Abilities / Skills: Students... • explain the principles behind the different soft computing algorithms • compare the different methods, assess them and select the best suitable for any given problem • apply the different methods to the problem in-question
(Study-Specific) Prerequisites	-
(recommended) Requirements	Basic knowledge in textile processing
References	• Vorlesungsumdruck (erhältlich am ITA und IKV), zahlreiche Abbildungen • Online-Vorlesung auf der Homepage des ITA
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation • Written Exam (schriftliche Prüfung) or • Oral Exam. (mündliche Prüfung)
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Modeling and Simulation in Textile Engineering (401148501)	3rd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise: Modellbildung und Simulation in der Textiltechnik	3rd semester	no semester recommended	-	2
Vorlesung Modellbildung und Simulation in der Textiltechnik	3rd semester	no semester recommended	-	2

Module titel	Reliable Simulation in the Mechanics of Materials and Structures (Compulsory elective subject)
Identifier	4011496
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1. Verification, validation and prediction: general definitions within the field of Computational Mechanics. 2. Abstraction and idealization of a physical problem: based on examples, the processes of abstraction and idealization from a real world problem into a mathematical model (depending on the aim of simulation) will be clarified. The influence of faulty idealization will be thoroughly discussed. 3. Verification of a model: to ensure the accuracy of the numerical implementation of the mathematical model, the results will be compared with a reference solution (e.g. analytical solution). 4. Factors affecting the FEM implementation: time integration scheme (explicit or implicit) , time step size, element type, static or dynamic model, linear or non-linear model geometric non-linearity, etc. . 5. Validation of a model: by comparison of a numerical model with reality (e.g. experimental results, complete systems). 6. Solving coupled problems: suitable solution strategies for weakly and strongly coupled problems. Example: differential equations of a coupled spring, damper and mass system. 7. Example of strongly coupled problems: multiphase porous media. 8. Introduction to multi-scale modeling: Effect of the time scale and space dimensions on the choice of the modeling method (nano- to micro- to macro-scale). Example: applying the molecular-dynamics simulation to solve problems on the nano-scale.
Learning Objectives/ Learning Outcomes	Wissen und Verstehen Overall goal: After successfully completing this course, the student will have acquired the following learning outcomes: 1. Adjusting the model complexity in relation with the modeling objective. 2. How the level of model complexity influences the computational efforts. 3. The process of determining how a model implementation accurately represents the developer's conceptual description and specification (verification). 4. The process of determining the degree to which a model is an accurate representation of the real world response (validation). 5. Choice of a suitable constitutive model based on experimental results. 6. Influence of the chosen time-integration scheme on the numerical results. 7. How time scale and space dimensions affect the choice of the numerical scheme. Fertigkeiten und Kompetenzen Students are able to: 1. Determine the suited level of model complexity in order to simulate a given physical problem efficiently and reliably. 2. Select the appropriate simulation techniques, e.g. in the case of FEM: explicit/ implicit or splitting time stepping schemes, element type and order. 3. Interpret computed results and asses their reliability. Competences: 1. After finishing this course, the students will have better understanding and critical thinking with regard to material modeling and numerical simulation.

	2. The acquired information help to justify the efficiency and accuracy of the simulation when applying either commercial numerical tools (as often applied in companies) or also when using open-source computational tools (as often used in universities and research centers). Sonstiges (fakultativ)
(Study-Specific) Prerequisites	-
(recommended) Requirements	Notwendige Voraussetzungen • none Empfohlene Voraussetzungen • This course is designed for students who are familiar with the foundations of simulation techniques. Therefore, it is recommended that they have succeeded the following modules: - Module: Numerical Methods in Mechanical Engineering - Module: Finite Element Methods for Engineers
References	Veranstaltungsliteratur 1. Murray-Smith, David J. : Testing and Validation of Computer Simulation Models: Principles, Methods and Applications (Simulation Foundations, Methods and Applications). ISBN: 978-3-319-15099-4, Springer Int. (2015) 2. Oberkampf,William L. Roy, Christopher J.: Verification and Validation in Scientific Computing. Cambridge (2010) Empfohlene weiterführende Literatur 1. Markert, B.: Weak or strong : on coupled problems in continuum mechanics. Habilitation, Report No. II-20, Institute of Applied Mechanics (CE), University of Stuttgart (2010)
Language	English
Examination Terms	Eine schriftliche oder mündliche Prüfung (abhängig von der Teilnehmerzahl)
Miscellaneous	-
Module coordinator	Dr.-Ing. Yousef Heider Universitätsprofessor Dr.-Ing. Bernd Markert
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Reliable Simulation in the Mechanics of Materials and Structures (401149601)	2nd semester	no semester recommended	6	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Übung Reliable Simulation in the Mechanics of Materials and Structures	2nd semester	no semester recommended	-	2
Vorlesung Reliable Simulation in the Mechanics of Materials and Structures	2nd semester	no semester recommended	-	2

Module titel	Practical Introduction to FEM-Software I (Compulsory elective subject)
Identifier	4012292
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• General introduction, development of FEM program, ANSYS (graphical interface) Modeling and calculation of frameworks with ANSYS Modeling of beam structures ANSYS commandos, Working with input data Post processing for beam elements • General introction in FEM program CALCULIX Modeling and calculation of beam structures with CALCULIX Data exchange between ANSYS - CAlCULIX • Introduction in 2D modeling with ANSYS (part 1) 2D element types, free networking, boundary conditions, network density, post processing Commandos for 2D modeling in CALCULIX boundary conditions, network density, post processing • Introduction in 2D modeling with ANSYS (part 2) Structured networking (mapped mesh), “bottom up”-/ “top down” – approach ANSYS commandos for heat transfer problems • APDL, Element types, boundary conditions, h- and p-method Post processing, estimation of errors • ANSYS 3D modeling (part 1), geometry creation, selection and grouping commands • 3D models (part 2), ANSYS- and CALCULIX commandos, 3D element types • 3D models (part 3), ANSYS- and CALCULIX commandos, extrusion of 2D models. • Project work, modeling • Project work, modeling, calculation, post processing • Project work, documentation, report • Revision course
Learning Objectives/ Learning Outcomes	Fachbezogene Lernziele: Providing an overview and introduction to Finite Element Software The students will: • Have sufficient practical and theoretical knowledge for the use of ANYSS and CALCULIX • be able to create smaller 2D and 3D FE models • be able to solve linear structural and heat transfer problems • Understand the concept of “Solid Modelling” and networking • Know the most important commands for creating input files • Know how to define boundary conditions and loading cases • Be able to test smaller FE models and to analyze possible errors • Be able to critically review the computing results in the post processor • Be able to deduce practical construction instructions from an FE calculation Nicht fachbezogene Lernziele: The students will • learn to work on a task in a team and to document and present the results in the form of a report • learn how to analyze problems • learn how to develop solutions and to evaluate them
(Study-Specific) Prerequisites	-
(recommended) Requirements	Empfohlene Voraussetzungen (z.B. andere Module, Fremdsprachenkenntnisse, …): • Command of English Voraussetzung für (z.B. andere Module, ...): • Practical Introduction to FEM-Software II
References	• Script • Online documentation, user handbooks
Language	English
Examination Terms	Practical Introduction to FEM-Software I

Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. (RUS) Mikhail Itskov
ECTS Credits	5
Contact time (WSH)	-
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	-
Self-study hours (h)	-

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Practical Introduction to FEM-Software I (401229201)	3rd semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Vorlesung/Labor Practical Introduction to FEM-Software I	3rd semester	no semester recommended	-	-

Module titel	Numerical Methods in Mechanical Engineering (Compulsory elective subject)
Identifier	4011449
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	The content of the course is to provide a map to follow the long and winding road from intuitional perception to the mathematical formulation of engineering problems. The content is summarized as follows: • Selected assumptions and mathematical tools to formulate problems • An overview of several solution methods: analytical solutions, approximate solutions, direct approximation, approximate solution after transformation of the problem • An overview of selected types of physical problems: discrete systems, continuous systems, equilibrium problems, eigenvalue problems, propagation problems • Integral formulations • Weak formulation of problems • The Method of Weighted Residuals • Introduction to variational calculus • Functionals • Functionals associated with an integral form • The stationarity principle • Stationarity conditions • Examples from mechanics • The method of Lagrange multipliers • Mixed and complementary formulations • Catalogue of functionals used in continuum mechanics and their specific features • Discretisation of integral forms • Collocation by points • Collocation by subdomains • Galerkin’s method Least Squares Method Examples • Ritz' method • Examples • Numerical integration • Newton-Cotes method • Gauss method Examples: • The Finite Element Method, Shape functions, construction of finite elements • Matrix representation in the FEM, Stiffness matrix, Boundary conditions • Examples from structural engineering, Software packages in engineering
Learning Objectives/ Learning Outcomes	Overall goal: The students will gain theoretical background of numerical methods commonly used in mechanical engineering. In particular, the physical formulations are discussed based on which the corresponding mathematical formulations for large-scale numerical methods are presented. In this course, students shall acquire the following:

	Knowledge / Understanding The students will understand • the theoretical foundations of current numerical methods in engineering • the bridge between the physical formulation of a problem and the mathematical description suited to implement numerical approximation methods • the steps and transformations required to implement numerical methods Abilities / Skills The students are able to • apply approximation techniques and analyse the results obtained by various numerical methods • use their acquired knowledge to develop state-of-the-art approximation methods • critically judge the consistency and correctness of numerical methods • apply variational methods to obtain formulations of a problem of differential equations • construct basis functions compatible with the boundary conditions • construct and apply a variety of approximation methods based on the WRM (collocation by points, collocation by subdomains, Galerkin's method, least squares method, Ritz method) • solve constrained optimization problems by using the Lagrange Multipliers Method • construct the associated energy potential and to apply the stationary principle for a conservative mechanical problem • apply basic tools of numerical integration
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	• Lecture Notes • Dhatt, G., Touzot, G.: The Finite Element Method Displayed. Wiley, New York, 1984. • Finlayson, B.A.: The Method of Weighted Residuals and Variational Principles. Academic Press, New York, 1972. • Reddy, J.N.: Energy and Variational Methods in Applied Mechanics. Wiley, New York, 1984. • Lemaitre, J., Chaboche, J.-L.: Mechanics of Materials, Cambridge Univ. Press, Cambridge, 1994. • König, J.A.: Shakedown of Elastic-Plastic Structures. Elsevier, Amsterdam, 1987.
Language	English
Examination Terms	Written exam or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Bernd Markert Dr. rer. nat. Michael Ban
ECTS Credits	7
Contact time (WSH)	5
Examination duration (min)	-
Total hours (h)	210,0
Contact hours (h)	75,0
Self-study hours (h)	135,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Numerical Methods in Mechanical Engineering (401144901)	3rd semester	no semester recommended	7	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Numerical Methods in Mechanical Engineering	3rd semester	no semester recommended	-	3
Tutorial Numerical Methods in Mechanical Engineering	3rd semester	no semester recommended	-	2

Module titel	Fundamentals of Lightweight Design (Compulsory elective subject)
Identifier	4011452
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1. Introduction to the Lightweight Design 1. Definition of lightweight design 2. General principles of lightweight design 3. Comparison of different materials 2. Statically indeterminate systems 1. Polplan 2. Force method 3. Reduction method 3. Beams under shear loading 1. Transverse shear in thin-walled closed cross-sections 2. St.-Venant‘s torsion 3. Warping torsion 4. Physical nonlinearity: Plastic bending and plastic hinge theory 5. Composite beam 6. Beam theory under large deformations (Th. II. Order) 7. Stability of beam structures and lateral torsional buckling 8. Structures of lightweight design 1. Shear web theory 2. Plane shear webs (2 dimensional) 3. Stiffened shear webs with three flanges
Learning Objectives/ Learning Outcomes	**Knowledge and Understanding:** In this course, students shall acquire the following: • the basic principles in order to optimize structures in terms of lightweight design, • the calculation of cutting forces in statically indeterminate systems, • the shear stress calculation of thin-walled closed sections, • the structural mechanical treatment of physical nonlinearity, • the calculation of composite beams, • the structural mechanical treatment of geometric nonlinearity, • the computational treatment of stability phenomena, • the structural and mechanical properties and characteristics of structures of lightweight design **Skills and competences:** Students shall be able to perform • the analyses of structural behavior of truss structures, • the design of load carrying structures as lightweight structures, • the stress calculations of truss structures under all loads in the aspect of lightweight design, • the geometrically and physically nonlinear analyses of truss structures, • the weight optimization of structures, • the interpretation of correctness of numerical simulation software and check whether the numerical results are feasible or not, • identification of engineering applications of lightweight design, develop suggestions, evaluate the obtained results and present the issues.
(Study-Specific) Prerequisites	-

(recommended) Requirements	Recommended requirements (e.g...): • Mechanics I and II • Material Science I and II • Machine Design • Advanced mathematics
References	• Hertel, H.: Leichtbau, Springer Verlag, 1960 • Wiedemann, J.: Leichtbau, Band I: Elemente, Springer Verlag, 1986 • Wiedemann, J.: Leichtbau, Band II: Konstruktion, Springer Verlag, 1989 • Czerwenka, G., Schnell, W.: Einführung in die Rechenmethoden des Leichtbaus, Band 1 und 2, BI-Hochschultaschenbücher • Roark, R. J., Young, W. C.: Formulas for Stress and Strain, McGraw-Hill, 1975 • Jones, R. M.: Mechanics of Composite Materials, McGraw-Hill, 1975 • Bruhn, E. F.: Analysis and Design of Flight Vehicles Structures • Niu, M. C. Y.: Airframe Structural Design, Conmilit Press Ltd., 1988
Language	English
Examination Terms	Written exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Kai-Uwe Schröder
ECTS Credits	4
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	120,0
Contact hours (h)	45,0
Self-study hours (h)	75,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Fundamentals of Lightweight Design (401145201)	2nd semester	no semester recommended	4	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Tutorial Fundamentals of Lightweight Design	2nd semester	no semester recommended	-	1
Lecture Fundamentals of Lightweight Design	2nd semester	no semester recommended	-	2

Module titel	Computational Fluid Dynamics I (Compulsory elective subject)
Identifier	4012278
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Introduction to CFD • Examples of flow simulatiaons • The basic PDE's of Fluid Mechanics • Different Notations • Physical meaning of characteristic lines • Determination of the type of PDE's • Characteristic form of PDE's • The basics of discretization of partial differentials • Truncation error and consistency • Solution schemes for scalar equations • Stability analysis of initial value problems • Discrete disturbance theory • von Neumann ananlysis • CFL-condition • Hirt's stability analysis • Introduction to the numerical solution of boundary value problems • Classical iterative solution methods, Jacobi, Gauß-Seidel methods • Convergence of iterative solution methods • ILU, Krylov subspace methods • Multigrid methods • Transformation of PDE's in curvlinear coordinates • Truncation error on curvelinear grids • Discretization on different unstructured meshes, solution adaptive methods • Triangle or tetrahedral based meshes • Hierarchical Cartesian meshes • Vectorization and parallelization of solution algorithms • Different applications and examples
Learning Objectives/ Learning Outcomes	• Knowledge of the partial differential equations (PDE'S) of fluid mechanics • Basics of the discretization of PDE's • Learn how to formulate numerical methods for the solution of PDE's • Ability to determine und understand the properties of truncation errors of numerical solution schemes • Understand stability and sonsistency of solution schemes • Solution of boundary value problems with iterative solution schemes • Discretization on different mesh types • Implementation of solution schemes on different computer architectures • The discussion of several examples of numerical flow simulation allows to understand different theoretical aspects in proactical mpplications
(Study-Specific) Prerequisites	-
(recommended) Requirements	recommended: • Basic knowledge in advanced mathematics • Basic knowledge in thermodynamics
References	• C.A. Fletcher: Computational Techniques for Fluid Dynamics Vol I+II, Springer Verlag, 1988

	• J.R. Anderson: Computational Fluid Dynamics, MacGraw-Hill, 1955 • C. Hirsch: Numerical Computation of Internal and External Flows, J. Wiley &; Sons, 1988 • P.J. Roache: Fundamentals of Computational Fluid Dynamics, hermosa publishers, Albuquerque
Language	English
Examination Terms	Written exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Wolfgang Schröder
ECTS Credits	4
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	120,0
Contact hours (h)	45,0
Self-study hours (h)	75,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Computational Fluid Dynamics I (401227801)	2nd semester	no semester recommended	4	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise Computational Fluid Dynamics I	2nd semester	no semester recommended	-	1
Lecture Computational Fluid Dynamics I	2nd semester	no semester recommended	-	2

Module titel	Industrial Logistics (Compulsory elective subject)
Identifier	4011473
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Objectives and tasks of logistics • Organisational involvement of logistics • Exercise: Prozess optimisation • Material flow design • Recitation by an external • Information logistics • Exercise: "Beergame" • Development and Procurement • Exercise: Development and Procurement • Material and finished goods disposition • Exercise: Workshop on the Enhancement of Disposition Quality • Distribution logistics • Exercise: Opening proceedings for tour planning • Spare part logistics • Recitation by an external • Logistics controlling • Exercise: ABC, XYZ Analysis
Learning Objectives/ Learning Outcomes	Students know objectives and tasks of industrial logistics as well as main aspects of industrial logistics from organisational involvement to logistics controlling. Students understand the meaning and the effects of individual aspects of industrial logistics and can place them in the overall context.They can apply the knowledge acquired to practical problems.
(Study-Specific) Prerequisites	-
(recommended) Requirements	-
References	-
Language	English
Examination Terms	Written exam or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Dipl.-Wirt. Ing. Günther Schuh apl. Professor Dr.-Ing. Volker Stich
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-

Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Industrial Logistics (401147301)	2nd semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise Industrial Logistics	2nd semester	no semester recommended	-	1
Lecture Industrial Logistics	2nd semester	no semester recommended	-	2

Module titel	International Factory Planning (Compulsory elective subject)
Identifier	4011481
Version	V2_neu
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Summer semester 2021
Valid until	-
Module level	Master
Content	L1 - Introduction to Factory Planning & Project Management: • basic glossary, different viewpoints, challenges and requirements of factory planning L2 - Target Definition & Product/Process Planning: • definition of objectives with the involvement of different stakeholders and requirements • challenges and approaches of product and process planning within the framework of factory design L3 - Location Planning & Site Structure Planning: • current trends in site structure planning and methods for evaluating different plant structure alternatives in order to create a basis for one of the most essential decisions within the factory planning process L4 - Industrial Building & Building Planning: • factory planning on the building side, i.e. advantages and disadvantages of different bearing structures, roof constructions and facade types L5 - Production Structure Planning & Capacity Planning: • production structure within the plant according to the site structure planning • challenges and approaches of capacity planning L6 - Layout Planning & Workplace Design: • overview of the goals and challenges of layout planning and the even more detailed workplace design L7 - Highlight lecture: • state-of-art application of modern factory planning methods
Learning Objectives/ Learning Outcomes	Within the framework of the lecture Factory Planning, the state-of-the-art of the respective subject areas will be introduced, relevant methods and procedures will be explained and reference solutions will be presented. The contents will be deepened in the exercises and in the case study. In this way, future production managers will be able to comprehensively plan and develop individual production sites as well as entire production networks of internationally active companies. The lectures and exercises as weil as the case studies are only held in summer semesters. The case studies are conducted in group work. A successful registration for the module Factory Planning already at the very beginning of each summer semester is therefore vital in order to be integrated within the allocation to groups. Each group then collaborates as a planning team to work on the case study, but members are graded individually. However, the exam can be written each semester, which means that the requirement of the case study has to be fulfilled (passed with a grade of 4.0 or better) to take the exam. lf an exam is failed, but the case study has already been completed, the grade of the case study is credited in the following semester. The aim of these case studies is to deepen the contents conveyed in the lecture in a practical application. The students are presented with a real-world-oriented factory planning problem. In order to successfully perform an extensive analysis covering multiple planning levels and give decision-targeted recommendations, the concepts and methods learned from the lectures and excercises need to be rigorously applied. By emulating a real factory planning project, students are prompted to work together and transfer their knowledge into practice. In addition, the developed solutions are to be validated using

	simulation tools provided by the chair, e.g. for verifying material flows. Finally, the used procedures and achieved results are compiled into a case study report. The case study work is expected to run from May to June in the summer semester and must therefore be submitted before the written exam phase. Knowledge / Understanding - describe the characteristics and challenges of factory planning and with regard to the global environment - formulate the object precisely and in a detailed way - have an extended understanding of state of the art planning process of factories - know and understand the definition of the own value adding scope, the choice and allocation of suitable production locations, the conception of production systems and the usage of suitable planning tools. - understand the procedures and methods in factory planning Abilities / Skills - apply the acquired methods to design a factory - apply this knowledge to analyse organizational structures and forms of production Competencies - analyse the initial situation of a factory planning project, draft and classify possible solutions - define and develop single production plants as well as production networks of globalized companies and explain them to different target groups
(Study-Specific) Prerequisites	-
(recommended) Requirements	-
References	Lecture reprint Exercise reprint Sample solution reprint
Language	English
Examination Terms	The final grade is composed to 2/3 of the exam grade and to 1/3 of the case study grade (individual grading). Both parts have to be passed in order to pass the whole module. Bonus points are awarded for the e-Test in L2P: Tests with 5-6 questions per lecture unit; time limited to 30 minutes activation from the day of the lecture to the day before the following lecture or max. 1 week > 50% of questions correct (i.e. 3 questions) - > test passed! 1 bonus point per test-> Max. 6 bonus points reachable (5% of all points reachable in the exam)
Miscellaneous	-
Module coordinator	Univ.-Prof. Dr.-Ing.Günther Schuh
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam International Factory Planning (401148101)	2nd semester	no semester recommended	4	0
Case Study International Factory Planning (401148102)	2nd semester	no semester recommended	2	-

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise International Factory Planning	2nd semester	no semester recommended	-	2
Lecture International Factory Planning	2nd semester	no semester recommended	-	2

Module titel	Artificial Neural Networks in Structural Mechanics (Compulsory elective subject)
Identifier	4021387
Version	V1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2021
Valid until	-
Module level	Master
Content	Classical structural mechanics is based on continuum mechanics using tensor calculus, differential geometry, and modelling of inelastic material behaviour. This theoretical approach established in the 20th century is the basis for finite element programs widely used in industry and science. Innovative approaches by means of artificial neural networks are known to be very efficient to describe complex mathematical dependencies. This effect relies on the self-learning ability of neural networks to reproduce dependencies between mechanical quantities such as stresses, strains, or other state variables. However, the neural network is based on experience and has therefore tobe trained by experimental or numerical data. Once the neural network has been trained, it is able to predict structural deformations in shorter calculation times than by using classical numerical approaches. Also the accuracy does not suffer, even though that program codes of neural networks are shorter than classical finite element codes. In order to apply the new knowledge on practical examples, the students will learn how to develop a virtual copy of the engineering structure by means of a neural network. Here, a wide variety of components in the network with different layers, neurons, activation functions etc. is available and must be ordered for the application. Special attention is focused on the combination of artificial neural networks with the finite element method. Following this approach, advantages of mesh generation and equation solvers in finite element programs are used and parts of the classical mechanical models are replaced by neural networks. E.g. material models are substituted by trained neural networks leading to shorter simulation times. Due to the fact that artificial neural networks are becoming more widespread in engineering disciplines, students will be familiar with this new trend in simulation methods after visiting this course. They will gain the competences to support the development of neural network enhanced modelling and simulation in industrial and scientific applications.
Learning Objectives/ Learning Outcomes	The aim of the course is to enable students to work with artificial neural networks from the viewpoint of engineering science. This implies to understand different network topologies and their applications in structural mechanics. Classical structural models will be replaced by artificial neural networks partly or completely depending on the current problem. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> Students: • shall understand the topology of artificial neural networks • are to gain an overview and learn motivation of network architectures (weights, bias-terms, sensilivity analysis) • are to understand different network topologies and their applications in structural mechanics • shall describe mathematical models of artificial neural networks • are to describe possible applications of artificial neural networks in structural mechanics • shall model structures enhanced by neural networks • shall program artificial neural networks • are to find solutions for differential equations approximated by neural networks • shall develop intelligent elements and know the processes behind neural network enhanced finite element simulatios

	Abilities / Skills Students: • are expected to apply artificial neural networks for numerical predictions in structural mechanics • shall program neural networks and train them by data gained from experiments or simulations • shall train artificial neural networks by means of measurement and simulation data • shall model inelastic material behaviour with artificial neural networks • are expected to apply the enhancement of finite element simulation by neural networks Competencies: Students: • shall develop intelligent elements by combining neural networks with the finite element method • are to increase the efficiency of structural calculations towards faster simulations and new structural models without material parameters trained just by experimental or simulated data • are expected to choose, depending on the current problem, whether to replace classical structural models partly or completely by artificial neural networks • shall work with artificial neural networks from the viewpoint of engineering science
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended: • Mechanik I-III • Nonlinear Structural Mechanics
References	• Lecture Notes • Empfohlene weiterführende Literatur: A. Engelbrecht, Computational lntelligence, An lntroduction, JohnWiley Literatur & Sens, Ltd, 2007.
Language	English
Examination Terms	An oral or a written exam
Miscellaneous	-
Module coordinator	Prof. Dr.-lng. Marcus Stoffel
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Prüfung Artificial Neural Networks in Structural Mechanics (402138701)	3rd semester	no semester recommended	6	-

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Artificial Neural Networks in Structural Mechanics	3rd semester	no semester recommended	-	2
Exercise Artificial Neural Networks in Structural Mechanics	3rd semester	no semester recommended	-	2

Module titel	Intelligent Monitoring of Engineering Systems (Compulsory elective subject)
Identifier	4021494
Version	V1_neu
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	The course curriculum consists of seminar lectures followed by a semester project. During the seminar lectures, the students will receive the necessary theoretical background to independently plan and execute the project in small groups. Consultation hours are offered to discuss challenges and problems arising during the course of the project. Finally, each group presents their achievements and results live and in form of a written report. The following topics are covered: • Sensing • Signal processing • Machine learning • Non-Destructive Testing (NDT) • Structural Health Monitoring (SHM) • Data pre- and postprocessing using MATLAB
Learning Objectives/ Learning Outcomes	In this course, students shall acquire the following: Knowledge / Understanding The students will understand • the theoretical foundations of structural health monitoring approaches in engineering • state-of-the-art and current trends in structural health monitoring • the fundamentals of sensors, filtering methods, and computational Intelligence Abilities / Skills The students are able to • describe and analyse mechanical engineering systems • extract and monitor relevant system parameters • apply fundamental methods of structural health monitoring • transfer their knowledge to new engineering applications in science and industry • independently plan, advance and complete projects
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended: Programming experience, particularly in MATLAB (Python)
References	Farrar, C.R. and Worden, K., 2012. Structural Health Monitoring: A Machine Learning Perspective. Wiley.
Language	English
Examination Terms	Written or Oral Examination (100 %)
Miscellaneous	-

Module coordinator	Univ.-Prof. Dr.-Ing. Bernd Markert
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Intelligent Monitoring of Engineering Sys-tems (402149401)	2nd semester	no semester recommended	5	-

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Intelligent Monitoring of Engineering Systems	2nd semester	no semester recommended	-	2
Exercise Intelligent Monitoring of Engineering Systems	2nd semester	no semester recommended	-	1

Module titel	Quality Management (Compulsory elective subject)
Identifier	4011453
Version	V2
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	The digitalization and networking of production increases the availability of data over the entire product life cycle and changes the role of quality management in relation to systems, processes and products. With the shift in focus of data analysis from reactive and corrective to proactive and predictive, the principles of quality management remain, but actors acting in quality management need new tools, e.g. from the domain of machine learning, to deal with increased complexity. The lecture deals with the interweaving of quality-related methods with the needs of a rapid situation clarification of possibly deviating processes along value chains or the associated industrial services. The orientation towards the structure of the "Internet of Production" first builds on the principles of quality management (e.g. important standards, clarification of the terms system, process and product quality). The identification of quality relevant data sources (incl. social media) along the product life cycle leads to the modelling of the data-information-knowledge pyramid. The statistical/stochastic basics serve as a fundamental basis to understand methods of data analytics and machine learning and are applied situationally to typical problem classes from different areas of quality management (e.g. process control, risk management, fault management), which are typified with regard to their structure and thus made accessible for rationalization. The goal is to increase the action competence of actors by decision support (e.g. by the use of smart devices). Contributions from practice give insight into the implementation of quality management in industry.
Learning Objectives/ Learning Outcomes	Knowledge Students shall know • Important standards and guidelines in the knowledge domain "quality management" • structure of standards (high-level structure) • System, process and product quality • Quality relevant data and data sources along the product life cycle • Statistical and methodical basics of "lndustrial lntelligence" as a core task of QM • Legal implications Understanding Students shall understand • The "Internet of Production" • The importance of quality and machine learning methods in networked adaptive production • Importance of quality and quality management in networked, adaptive production • The Classification of typical problems • basic data analytics and machine learning methods Students shall be able to apply: • Data collection (e.g. customer insights in the product development process and during product usage, data-driven procurement management) • selected data analytics and machine learning methods (e.g. for risk quantification and prediction, process control) • Quality management for services • Decision support of the "Smart Quality Expert" (e.g. predictive quality, predictive maintenance) Skills and Competencies Students

	• shall develop an understanding of the different forms of the quality concept that can be operationalized in the operational process and classify them in the sense of "Industrial Intelligence". • shall be able to identify and classify problems in the corporate context. • shall have basic knowledge in the field of machine learning, shall know corresponding advanced quality management methods and be able to describe their specific applicability and effectiveness. • shall be able to theoretically and practically penetrate applications in the quality management domain with the knowledge imparted to them as a 'tool'. • shall be able to build up the structure of an "lndustrial lntelllgence" by means of quality management methods in the corporate context, to evaluate it with regard to its effectiveness and to further develop and meaningfully link quality management methods based on an understanding of interrelationships and principles. • shall be able to intervene in value chains in an improving way based on their well-founded methodological and organizational knowledge. • shall be able to recognize and evaluate situations, strengths and weaknesses of an existing quality management system and to formulate suitable measures for a coherent further development. The contents are based on research of the Cluster of Excellence "Internet of Production". Considering this background, the participants should take the mental transformation from the application of tools (methodological competence) to the design of the underlying principles and cause-effect relationships in value chains (action competence).
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	• Lecture Notes • Students also receive a list of relevant literature
Language	English
Examination Terms	Written (100 %)
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Robert Schmitt
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Quality Managment (401145301)	3rd semester	no semester recommended	6	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Tutorial Quality Management	3rd semester	no semester recommended	-	4

Module titel	Computational Intelligence in Engineering (Compulsory elective subject)
Identifier	4021493
Version	V1_neu
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	The elective course “Computational Intelligence in Engineering“ is available for students enrolled in the engineering Master programs of RWTH Aachen University. It provides an overview over recent applications of computational intelligence and deep learning that are relevant to engineering. The first half of the course content is a theoretical introduction into the topic of machine learning in engineering and programming fundamentals in Python. In the second half of the course, the students apply their gained knowledge in project-based learning. The course will be taught interactively, engaging the students using practical example projects. The following topics are covered: • Time-variant dynamic processes from simulations or experiments • Data acquisition and pre-processing • Machine learning algorithms and neural network models • Advanced neural networks architectures • Project-specific engineering problems • Programming fundamentals in Python for data-driven procedures
Learning Objectives/ Learning Outcomes	The course curriculum consists of interactive seminar lectures accompanied by semester project works. During the seminar lectures, the students will receive the necessary theoretical information and supervision to independently plan, advance and complete the projects in small groups. In addition, the seminars offer the opportunity to discuss challenges and problems arising during projects. Finally, the achievements and results obtained within the student projects will be presented by the students in the scope of the seminar lectures and the accompanying computer lab exercises. <u>Knowledge / Understanding</u> The students will understand • current trends in computational intelligence and their theoretical foundation in the context of engineering applications • the advantages of machine learning algorithms in engineering but also the limits of the methods and when better not to use them <u>Abilities / Skills:</u> The students will be able to • apply machine learning methods to a wide variety of engineering Problems • transfer their knowledge to new engineering applications in science and industry via the practical expertise gained • evaluate the merits and limitations of machine learning methods applied to computer aided engineering problems
(Study-Specific) Prerequisites	-
(recommended) Requirements	Programming experience is advantageous, preferably the language Python.
References	• Goodfellow, I., Bengio, Y., Courville, A., 2016. Deep Learning. MIT Press.

	• Keller, J.M., Liu, D., Fogel, D.B. , 2016. Fundamentals of Computational Intelligence. IEEE Press, Wiley.
Language	English
Examination Terms	Written Examination or Oral Examination (100 %)
Miscellaneous	-
Module coordinator	Univ.-Prof. Dr.-Ing. Bernd Markert
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Computational Intelligence in Engineering (402149301)	3rd semester	no semester recommended	5	-

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture "Computational Intelligence in Engineering	3rd semester	no semester recommended	-	2
Exercise Computational Intelligence in Engineering	3rd semester	no semester recommended	-	1

Module titel	First Research Project (Compulsory subject)
Identifier	4014346
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	Project comprising the following steps: • survey of state-of-the-art • definition and (if possible) quantification of project goal • determination of necessary steps to achieve the goal • planning and carrying out the necessary trials etc. • documentation of results in written report • oral presentation
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: Abilities / Skills: The students… • learn how to do a literature survey • learn to work independently to a high degree with only little supervision Competencies: The students… • can define and quantify project goals • determine the necessary steps to achieve this goal • can document the achieved results • can orally present the results to an auditorium
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	-
Language	English
Examination Terms	The module grading is weighted according to the CP allocation Report (80 %) and oral presentation (20 %) (Bericht (80%) und mündliche Präsentation (20%))
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	8
Contact time (WSH)	0
Examination duration (min)	-
Total hours (h)	240,0

Contact hours (h)	,0
Self-study hours (h)	240,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam First Research Project (401434601)	1st semester	no semester recommended	8	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise First Research Project	1st semester	no semester recommended	-	0
Lecture: First Research Project	1st semester	no semester recommended	-	0

Module titel	Second Research Project (Compulsory subject)
Identifier	4015760
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	Project comprising the following steps: • survey of state-of-the-art • definition and (if possible) quantification of project goal • determination of necessary steps to achieve the goal • planning and carrying out the necessary trials etc. • documentation of results in written report • oral presentation
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: Abilities / Skills: The students… • design learning processes independently. • select scientific methods targeted target oriented to develop concepts for the solution of scientific problems • reflect the methods used and are able to expand their methodological skills according to new Competencies: The students… • in the light of new knowledge and information learns how to do a literature survey • define and quantify project goals • determine the necessary steps to achieve this goal • work independently to a high degree with only very little supervision • document the achieved results • orally present the results to an auditorium
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	-
Language	English
Examination Terms	The module grading is weighted according to the CP allocation Report (80 %) and oral presentation (20 %) (Bericht (80%) und mündliche Präsentation (20%))
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	16
Contact time (WSH)	0

Examination duration (min)	-
Total hours (h)	480,0
Contact hours (h)	,0
Self-study hours (h)	480,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Examination: Second Research Project (401576001)	2nd semester	no semester recommended	16	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Second Research Projec	2nd semester	no semester recommended	-	0
Exercise Second Research Project	2nd semester	no semester recommended	-	0

Module titel	Technical Textiles (Compulsory elective subject)
Identifier	4012458
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Bachelor/Master
Content	1 • Einführung und Überblick: • Fasern und Textilien • Einsatzgebiete und Anwendungen • Märkte • Fertigungsstufen 2 • Rohstoffe 1: • Einteilung, Eigenschaften wichtiger Fasern, Kurzzeichen • Naturfasern: • Baumwolle (Sorten, Anbau, Ernte), Bast- und Hartfasern (Flachs, Hanf), • Wolle (Schafrassen, Gewinnung, Qualitäten) • Andere Naturfasern (feine Tierhaare, Seide, Asbest) 3 • Rohstoffe 2: • Synthetische Fasern: • Einteilung, Bildungsmechanismen, Strukturmodelle • Spinnprozesse (Schmelzspinnen, Lösungsspinnen) • Anlagentechnik • Polyester, Polyamid 4 • Rohstoffe 3: • Verarbeitung von Chemiefasern (Verstreckung, Texturierung, Spinnfaserherstellung, Konvertierung) • Glas (Aufbau, Spinnprozesse, Eigenschaften, Produkte) • Carbon (Aufbau, Spinnprozesse, Eigenschaften, Produkte) 5 • Spinnereivorbereitung 1: • Übersicht (Verfahren, wichtigste Prozessstufen) • Ernte und Entkörnung, Klassierung von Baumwollfasern • Ballenabarbeitung, Öffnung, Reinigung, Mischen (Prinzipien, Maschinen) 6 • Spinnereivorbereitung 2: • Karde (Funktion, Prinzip, Maschine, Komponenten) • Kämmen (Funktion, Prinzip, Maschine) 7 • Spinnverfahren 1: • Ringspinnen (Flyer, Ringspinnen - Prinzip, Maschine, Produkte) • Kompaktspinnen 8 • Spinnverfahren 2: • OE-Rotorspinnen (Prinzip, Maschine, Produkte) • OE-Friktionsspinnen (Prinzip, Maschine, Produkte)

• Luftspinnen (Luft-Falsch- und Luftechtdrahtverfahren)
• Vergleich der Spinnverfahren (Produktivität, Produkteigenschaften)

9
• Webereivorbereitung:
• Übersicht
• Spulen, Zwirnen
• Kettbaumherstellung (Zwirnen, Schären, Schlichten)

10
• Webmaschinen:
• Fachbildung (Prinzipien, Vor- und Nachteile, Maschinen, Einsatzgebiete)
• Schusseintragsverfahren (Prinzipien, Maschinen, Einsatzgebiete)
• Markt
• Gewebebindungen:
• Begriffe, Grundbindungen und Ableitungen

11
• Maschenwarenherstellung:
• Maschenbildeverfahren
• Nadeltypen
• Maschenbildende Maschinen (Strick- und Wirktechnik)
• Musterung, Einsatzgebiete, Markt

12
• Vliesstoffe:
• Rohstoffe
• Herstellungsverfahren (Prinzipien, Maschinen und Anlagen)
• Verfestigungsverfahren (Prinzipien, Maschinen)
• Einsatzgebiete, Markt

13
• Technische Textilien:
• Definitionen, Einteilung
• Anwendungsbeispiele
• Herstellungsverfahren (Prinzipien, Maschinen)

14
• Veredlung
• Vorbehandlung (Prinzipien, Maschinen und Aggregate)
• Hilfsprozesse (Prinzipien, Maschinen)
• Farbgebung (Farbmetrik, Farbstoffe, Färbeprinzipien, Färbeapparate)
• Appretur (Prinzipien, Maschinen)

15
• Konfektion:
• Markt
• Zuschnitt, Fügeverfahren (Prinzipien, Apparate)
• Recycling:
• Verfahren, Maschinen und Anlagen

Learning Objectives/ Learning Outcomes

- Die Studierenden besitzen einen Überblick über alle wichtigen Rohstoffe, Verfahren und Maschinen der Textilherstellung sowie über die entsprechenden Märkte.
- Sie können beschreiben, welche Rohstoffe zur Textilherstellung eingesetzt werden. Sie können erklären, wie die Fasern gewonnen bzw. erzeugt werden und welche besonderen Eigenschaften sie für die jeweiligen Anwendungsgebiete besonders geeignet machen.
- Die Studierenden können alle wichtigen Prinzipien, Prozesse und Maschinen bzw. Anlagen der Spinnereivorbereitung, der Garn-, Gewebe-, Maschenwaren- und Vliesstoffherstellung benennen, erläutern und ggf. bewerten.
- Sie können die Einteilung der Technischen Textilien sowie jeweils typische Anwendungsgebiete und Produkte benennen.
- Sie können die entsprechenden Werkstoffe und textilen Strukturen je nach Einsatzgebiet auswählen und bewerten.
- Sie können alle wichtigen Prozesse, Aggregate und Maschinen der Veredlung sowie der Konfektionierung beschreiben und erklären.
- Die Studierenden können die wichtigsten Verfahren des Recyclings darstellen und technologisch bzw. wirtschaftlich bewerten.

	• Die Studierenden sind in der Lage, einfache Rechnungen zur Auslegung der wichtigsten Maschinen der Textilherstellung auszuführen. Dazu gehören z. B. Berechnungen des Durchsatzes bei der Chemiefaserherstellung, die Fehlerortsbestimmung in Streckwerken, Berechnung der Produktivität von Flyer-, Ringspinn-, Rotorspinn- und Webmaschinen. • Die Studierenden haben in den praktischen Laborübungen gelernt, die wichtigsten Maschinen der Garn- und Gewebeherstellung zu bedienen. Die Lernziele werden erreicht durch die Vorstellung der beschriebenen Vorlesungsinhalte in den Vorlesungen sowie durch Rechenübungen und Vorführungen der relevanten Maschinen.
(Study-Specific) Prerequisites	recommended Basic knowledge in textile processing
(recommended) Requirements	keine
References	• Vorlesungsumdruck Textiltechnik I (erhältlich am ITA), 300 Seiten, zahlreiche Abbildungen • Literaturliste im Vorlesungsumdruck • Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine Klausur
Miscellaneous	-
Module coordinator	Modellierungsteamverantwortlicher: Philipp Friedl M. A. Modulverantwortlicher: Dr.-Ing. Dieter Veit Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Technical Textiles (401245801)	3rd semester	no semester recommended	6	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Übung Technische Textilien	3rd semester	no semester recommended	-	2
Vorlesung Technische Textilien	3rd semester	no semester recommended	-	2

Module titel	Fibre Science II (Compulsory elective subject)
Identifier	4013363
Version	-
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Bachelor/Master
Content	1 • Fundamentals of chemical fibres 1: • Definition, classification, symbols • Historical development • Market and trends, production, trade and consumption 2 • Fundamentals of chemical fibres 2: • Characteristic temperatures, cristallisation, orientation • Characteristic fibre properties (dullness, fineness, crosssection, length, degree of draft, crimp, yarn structure, stress-strain behaviour, thermal properties, dying) • Typical products made from chemical fibres (staple fibres, textile and technical filament yarns, carpet yarns, spunbonds, bicomponent fibres) 3 • Production of chemical fibres: Polymerisation, polycondensation, polyaddition (principle, reaction speed and throughput, molecular weight distribution) • Reacotr (function, types) • Pigmentation • Processing steps for the production of filament and staple fibre yarns 4 • Fundamentals of spinning: • Yarn formation (Law of Hagen-Poiseuille, spinnability, fibre cross-sections) • Important spinning processes (melt, dry and wet spinning) 5 • Common measures of all spinning processes: • Pipes, static mixers • Spin pumps, spinnerets • Quench duct, spinning preparation 6 • Melt spinning 1: • Polymer preparation (granulation, drying) • Melting and spinning (extruder, pipe flows, spinnerets, yarn formation, quench duct, through put) • Spinning systems (rectangular and round spinnerets) 7 • Melt spinning 2: • Spinning systems for staple fibres (oiling, drafting systems, crimp processes and machines, devices) • Textile filament yarns (POY, conventional, modified) 8 • Melt spinning 3: • Technical filament yarns (FDY, FOY) • Carpet filament yarns (BCF)

- Spunbonds
- Monofilaments

9

- Solution spinning:
- Dry spinning (spinning solution, yarn formation, processes)
- Wet spinning (spinning solution, yarn formation, processes)
- Air gap spinning
- Other spinning processes

10

- Drafting:
- Structural models, drafting spot, stress-strain curves
- Processes (godets, roller, DUOs)
- Drawspinning (principle, process, machine)
- Drawtwisting (principle, process, machine)
- Warp stretching (principle, process, machine)
- Sectional warping (prinpicle, machine)

11

- After-treatment:
- Washing, oiling
- Drying, fixation (filaments, cables, staple fibres), shrinkage
- Texturing processes
- Crimper, airjet texturing, false-twist processes

12

- Conversion of fibre cables:
- Cutting, tearing
- Bales:
- Bale pressing, winding
- Combination of processing steps (raw materials, spinning, fibre production, textile filaments, technical filaments, carpet yarns)
- Special testing processes for chemical fibres

13

- Polyester:
- History, synthesis, spinning processes, properties, products
- Direct spinning plants
- Markets, trends
- Special types (PBT, PTT)

14

- Polyamide:
- History, synthesis (PA 6, PA 6.6), spinning processes, properties, products
- Special types (PA 7, PA 6.10)
- Polyurethane (Elastane)

15

- Polyolefines:
- Polypropylene (synthesis, spinning processes, properties)
- Polyethylene (synthesis, spinning processes, properties)
- Polyacrylonitrile (synthesis, spinning processes, properties)

Learning Objectives/ Learning Outcomes

With respect to the subject:

- The students have an overview about all important chemical fibres, the resp. processes, machines and devices with economical or technological importance.
- They can explain, why the market shares of the fibre materials have shifted over time due to changes in technology, society and fashion.
- They can explain the methods by which the fibre materials are synthesised, which devices and machines are needed therefore and which are the advantages and disadvantages or the resp. technologies.
- They can explain the chemical composition of the fibre materials and derive their major physical and chemical properties from it. They can explain for which application the fibres are suited and for what reason.
- They can select and assess suitable processes for new fibre materials.
- The students can analyse new processes for the production or processing of chemical fibres and assess them with regard to technological feasibility and economical impact.

	• The students can design chemical fibre production plants, calculatute their layout, e.g. throughput, efficiency depending on number-of-end-down etc. • They can assess the economical feasibility of new spinning processes. • The students can run the most important machines for the production and the processing of chemical fibres. Not with respect to the subject (e.g. Team work, Presentation, Project Management, etc.): • The students have learned in a team to get a machine running for the processing of chemical fibres.
(Study-Specific) Prerequisites	-
(recommended) Requirements	Reccommended Requirements (e.g.. other Modules, foreign languages, …): • Textile Technology 1 • Fibre Science 1
References	• Vorlesungsumdruck Faserstoffe 2 (erhältlich am ITA), 250 Seiten, zahlreiche Abbildungen • Literaturliste im Vorlesungsumdruck • Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine schriftliche Klausur
Miscellaneous	-
Module coordinator	Modulangebotsorganisator: Thomas Fieder B. Sc.Modellierungsteamverantwortlicher: Philipp Friedl M. A.Modulverantworlicher: Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	3
Contact time (WSH)	2
Examination duration (min)	0
Total hours (h)	90,0
Contact hours (h)	30,0
Self-study hours (h)	60,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Fibre Science II (401336301)	2nd semester	no semester recommended	3	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Exercise Fibre Science II	2nd semester	no semester recommended	-	2

Module titel	Textile Technology II (Compulsory elective subject)
Identifier	4011484
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1 • Geschichte der Textilherstellung: • Altertum, Mittelalter, Produktionsverfahren, Handel • Industrialisierung, Produktionstechnik, soziale Entwicklung 2 • Prozesslinien in der Spinnerei: • Kurzstapelverfahren • Langstapelverfahren • Streichgarnverfahren und sonstige Prozesse 3 • Baumwollernte und -entkörnung: • Ernte, Entkörnung • Yield, Ballenpresse, Trends 4 • Öffnen, Reinigen, Mischen: • Prinzipien, Technologien • Maschinen 5 • Karde 1: • Garnituren, Flockenspeiser, Vorreißer • Tambour, Abnehmer, Bandbildung 6 • Karde 2: • Regel- und Steuersysteme, Antriebskonzepte • Absaugung, Trends 7 • Strecke: • Einlauf, Streckwerk, Vorverzug • Regulierung, Bandablage, Antriebe • Häkchentheorie, Mischstrecken, integrierte Strecken, Trends 8 • Kämmmaschine: • Kämmereivorbereitung • Kämmmaschinen, Linien • Trends 9 • Flyer: • Aufbau und Funktion, Streckwerk, Flügel • Aufwicklung, Doffen • Antriebe, Automatisierung, Trends

	10 • Ringspinnen: • Prinzip, Streckwerk, Ring-Läufer-Systeme, Maschinen • Theoretische Grundlagen, Trends 11 • Kompaktspinnen: • Prinzip, Streckwerke, Trends • Direktspinnen: • Prinzip, Streckwerk, Maschinen 12 • Spulen: • Begriffe, Wicklungsarten, Changierverfahren • Qualitätssicherung, Spulenformen, Spulmaschinen, Trends 13 • OE-Rotorspinnen: • Prinzip, Aggregate, Maschinen • Theoretische Betrachtungen, Falschdraht, Trends 14 • Luftspinnen: • Prinzipien, Maschinen • Trends 15 • Sonstige Spinnverfahren: • Überblick über nicht-konventionelle Spinnverfahren, • z.B. Topfspinnen, Self-Twist, Adhäsionsverfahren, Bobtex
Learning Objectives/ Learning Outcomes	Fachbezogen: • Die Studierenden können alle relevanten Verfahren und Maschinen der Spinnereivorbereitung und der Spinnerei erklären, gegenüber stellen, bewerten und kritisch vergleichen. • Die Studierenden besitzen umfassende Kenntnisse über die den einzelnen Prozessen zugrunde liegenden physikalischen Prinzipien. • Die Studierenden sind in der Lage, darauf aufbauend neue Spinnverfahren zu analysieren und zu bewerten. • Die Studierenden können unterschiedliche Maschinenkonzepte bewerten und kritisch vergleichen. • Die Studierenden sind mit den heute üblichen Antriebs- und Steuerungs- bzw. Regelungskonzepten der entsprechenden Textilmaschinen vertraut, sie können sie erklären und beurteilen. • Die Studierenden haben alle am ITA vorhandenen und in den Übungen behandelten Spinnereivorbereitungsmaschinen und Spinnmaschinen bedient und sind so mit den wichtigsten Einstellungskriterien vertraut. • Die Studierenden können zu allen relevanten Maschinen Berechnungen zur Produktivität und Auslegung durchführen. Die Lernziele werden erreicht durch die Vorstellung der beschriebenen Vorlesungsinhalte in den Vorlesungen sowie durch Rechenübungen und Vorführungen der relevanten Maschinen. Nicht fachbezogen (z.B. Teamarbeit, Präsentation, Projektmanagement, etc.): • Durch die praktischen Übungen an den Maschinen lernen die Studierenden, im Team Problemstellungen selbständig und unter Anleitung zu lösen.
(Study-Specific) Prerequisites	recommended Basic knowledge in textile processing.
(recommended) Requirements	Empfohlene Voraussetzungen (z.B. andere Module, Fremdsprachenkenntnisse, …): • Textiltechnik I
References	• Vorlesungsumdruck (erhältlich am ITA), 320 Seiten, zahlreiche Abbildungen • Literaturliste im Anhang des Umdrucks

	• Online-Vorlesung auf der Homepage des ITA
Language	German
Examination Terms	Eine Klausur
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Textile Technology II (401148401)	3rd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Übung Textiltechnik II	3rd semester	no semester recommended	-	2
Vorlesung Textiltechnik II	3rd semester	no semester recommended	-	2

Module titel	Modeling and Simulation in Textile Engineering (Compulsory elective subject)
Identifier	4011485
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Factorial design • Basics of simulation, modeling and soft computing • Neural networks (principles, algorithms, applications) • Genetic algorithms and evolution strategy (principles, applications) • Fuzzy logic (principles, algorithms, applications) • Computational fluid dynamics (principles, algorithms, applications) • Digital image processing (principles, algorithms, applications)
Learning Objectives/ Learning Outcomes	After successfully completing this course, the students will have acquired the following learning outcomes: Abilities / Skills: Students... • explain the principles behind the different soft computing algorithms • compare the different methods, assess them and select the best suitable for any given problem • apply the different methods to the problem in-question
(Study-Specific) Prerequisites	recommended Basic knowledge in textile processing
(recommended) Requirements	Basic knowledge in textile processing
References	• Vorlesungsumdruck (erhältlich am ITA und IKV), zahlreiche Abbildungen • Online-Vorlesung auf der Homepage des ITA
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation • Written Exam (schriftliche Prüfung) or • Oral Exam. (mündliche Prüfung)
Miscellaneous	-
Module coordinator	Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Modeling and Simulation in Textile Engineering (401148501)	3rd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise: Modellbildung und Simulation in der Textiltechnik	3rd semester	no semester recommended	-	2
Vorlesung Modellbildung und Simulation in der Textiltechnik	3rd semester	no semester recommended	-	2

Module titel	Selected Topics in Textile Technology (Compulsory elective subject)
Identifier	4015718
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	Recycling von Fasern, Garnen und TextilienSpezialtextilmaschinenFlockverfahrenSonderwebtechnikenSpezielle TextilveredlungsverfahrenBekleidungsfertigungTextiler Anlagenbau
Learning Objectives/ Learning Outcomes	After successfully completing this course, the student will have acquired the following learning outcomes: **Knowledge / Understanding** Students • know relevant technological principles of the shown subjects and topics • know advantages and disadvantages of machines and processes and can explain advantages and disadvantages **Abilities / Skills** Students learn • how to apply their knowledge from a prior Bachelor degree to advanced problems and challenges of textile engineering **Competencies** Students • work in teams, independently and under supervision to solve given problems due to small-group practical exercises
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended • Textiltechnik I, II, III • Technische Textilien
References	Vorlesungsumdruck Literaturliste im L2P
Language	English
Examination Terms	The module grading is weighted according to the CP-allocation Written Exam (schriftliche Prüfung) or Oral Exam. (mündliche Prüfung)
Miscellaneous	-
Module coordinator	Dr.-Ing. Dieter Veit Universitätsprofessor Professor h. c. (MGU) Dr.-Ing. Dipl.-Wirt. Ing. Thomas Gries
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0

Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Selected Topics in Textile Technology (401571801)	2nd semester	no semester recommended	6	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Exercise Selected Topics in Textile Technology	2nd semester	no semester recommended	-	4

Module titel	Practical Introduction to FEM-Software I (Compulsory elective subject)
Identifier	4012292
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• General introduction, development of FEM program, ANSYS (graphical interface) Modeling and calculation of frameworks with ANSYS Modeling of beam structures ANSYS commandos, Working with input data Post processing for beam elements • General introction in FEM program CALCULIX Modeling and calculation of beam structures with CALCULIX Data exchange between ANSYS - CAlCULIX • Introduction in 2D modeling with ANSYS (part 1) 2D element types, free networking, boundary conditions, network density, post processing Commandos for 2D modeling in CALCULIX boundary conditions, network density, post processing • Introduction in 2D modeling with ANSYS (part 2) Structured networking (mapped mesh), “bottom up”-/ “top down” – approach ANSYS commandos for heat transfer problems • APDL, Element types, boundary conditions, h- and p-method Post processing, estimation of errors • ANSYS 3D modeling (part 1), geometry creation, selection and grouping commands • 3D models (part 2), ANSYS- and CALCULIX commandos, 3D element types • 3D models (part 3), ANSYS- and CALCULIX commandos, extrusion of 2D models. • Project work, modeling • Project work, modeling, calculation, post processing • Project work, documentation, report • Revision course
Learning Objectives/ Learning Outcomes	Fachbezogene Lernziele: Providing an overview and introduction to Finite Element Software The students will: • Have sufficient practical and theoretical knowledge for the use of ANYSS and CALCULIX • be able to create smaller 2D and 3D FE models • be able to solve linear structural and heat transfer problems • Understand the concept of “Solid Modelling” and networking • Know the most important commands for creating input files • Know how to define boundary conditions and loading cases • Be able to test smaller FE models and to analyze possible errors • Be able to critically review the computing results in the post processor • Be able to deduce practical construction instructions from an FE calculation Nicht fachbezogene Lernziele: The students will • learn to work on a task in a team and to document and present the results in the form of a report • learn how to analyze problems • learn how to develop solutions and to evaluate them
(Study-Specific) Prerequisites	Empfohlene Voraussetzungen (z.B. andere Module, Fremdsprachenkenntnisse, &): Command of English
(recommended) Requirements	Empfohlene Voraussetzungen (z.B. andere Module, Fremdsprachenkenntnisse, …): • Command of English Voraussetzung für (z.B. andere Module, ...): • Practical Introduction to FEM-Software II
References	• Script • Online documentation, user handbooks
Language	English
Examination Terms	Practical Introduction to FEM-Software I

Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. (RUS) Mikhail Itskov
ECTS Credits	5
Contact time (WSH)	-
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	-
Self-study hours (h)	-

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Practical Introduction to FEM-Software I (401229201)	3rd semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Vorlesung/Labor Practical Introduction to FEM-Software I	3rd semester	no semester recommended	-	-

Module titel	Numerical Methods in Mechanical Engineering (Compulsory elective subject)
Identifier	4011449
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	The content of the course is to provide a map to follow the long and winding road from intuitional perception to the mathematical formulation of engineering problems. The content is summarized as follows: • Selected assumptions and mathematical tools to formulate problems • An overview of several solution methods: analytical solutions, approximate solutions, direct approximation, approximate solution after transformation of the problem • An overview of selected types of physical problems: discrete systems, continuous systems, equilibrium problems, eigenvalue problems, propagation problems • Integral formulations • Weak formulation of problems • The Method of Weighted Residuals • Introduction to variational calculus • Functionals • Functionals associated with an integral form • The stationarity principle • Stationarity conditions • Examples from mechanics • The method of Lagrange multipliers • Mixed and complementary formulations • Catalogue of functionals used in continuum mechanics and their specific features • Discretisation of integral forms • Collocation by points • Collocation by subdomains • Galerkin’s method Least Squares Method Examples • Ritz' method • Examples • Numerical integration • Newton-Cotes method • Gauss method Examples: • The Finite Element Method, Shape functions, construction of finite elements • Matrix representation in the FEM, Stiffness matrix, Boundary conditions • Examples from structural engineering, Software packages in engineering
Learning Objectives/ Learning Outcomes	Overall goal: The students will gain theoretical background of numerical methods commonly used in mechanical engineering. In particular, the physical formulations are discussed based on which the corresponding mathematical formulations for large-scale numerical methods are presented. In this course, students shall acquire the following:

	Knowledge / Understanding The students will understand • the theoretical foundations of current numerical methods in engineering • the bridge between the physical formulation of a problem and the mathematical description suited to implement numerical approximation methods • the steps and transformations required to implement numerical methods Abilities / Skills The students are able to • apply approximation techniques and analyse the results obtained by various numerical methods • use their acquired knowledge to develop state-of-the-art approximation methods • critically judge the consistency and correctness of numerical methods • apply variational methods to obtain formulations of a problem of differential equations • construct basis functions compatible with the boundary conditions • construct and apply a variety of approximation methods based on the WRM (collocation by points, collocation by subdomains, Galerkin's method, least squares method, Ritz method) • solve constrained optimization problems by using the Lagrange Multipliers Method • construct the associated energy potential and to apply the stationary principle for a conservative mechanical problem • apply basic tools of numerical integration
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	• Lecture Notes • Dhatt, G., Touzot, G.: The Finite Element Method Displayed. Wiley, New York, 1984. • Finlayson, B.A.: The Method of Weighted Residuals and Variational Principles. Academic Press, New York, 1972. • Reddy, J.N.: Energy and Variational Methods in Applied Mechanics. Wiley, New York, 1984. • Lemaitre, J., Chaboche, J.-L.: Mechanics of Materials, Cambridge Univ. Press, Cambridge, 1994. • König, J.A.: Shakedown of Elastic-Plastic Structures. Elsevier, Amsterdam, 1987.
Language	English
Examination Terms	Written exam or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Bernd Markert Dr. rer. nat. Michael Ban
ECTS Credits	7
Contact time (WSH)	5
Examination duration (min)	-
Total hours (h)	210,0
Contact hours (h)	75,0
Self-study hours (h)	135,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Numerical Methods in Mechanical Engineering (401144901)	3rd semester	no semester recommended	7	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Numerical Methods in Mechanical Engineering	3rd semester	no semester recommended	-	3
Tutorial Numerical Methods in Mechanical Engineering	3rd semester	no semester recommended	-	2

Module titel	Fundamentals of Lightweight Design (Compulsory elective subject)
Identifier	4011452
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1. Introduction to the Lightweight Design 1. Definition of lightweight design 2. General principles of lightweight design 3. Comparison of different materials 2. Statically indeterminate systems 1. Polplan 2. Force method 3. Reduction method 3. Beams under shear loading 1. Transverse shear in thin-walled closed cross-sections 2. St.-Venant‘s torsion 3. Warping torsion 4. Physical nonlinearity: Plastic bending and plastic hinge theory 5. Composite beam 6. Beam theory under large deformations (Th. II. Order) 7. Stability of beam structures and lateral torsional buckling 8. Structures of lightweight design 1. Shear web theory 2. Plane shear webs (2 dimensional) 3. Stiffened shear webs with three flanges
Learning Objectives/ Learning Outcomes	**Knowledge and Understanding:** In this course, students shall acquire the following: • the basic principles in order to optimize structures in terms of lightweight design, • the calculation of cutting forces in statically indeterminate systems, • the shear stress calculation of thin-walled closed sections, • the structural mechanical treatment of physical nonlinearity, • the calculation of composite beams, • the structural mechanical treatment of geometric nonlinearity, • the computational treatment of stability phenomena, • the structural and mechanical properties and characteristics of structures of lightweight design **Skills and competences:** Students shall be able to perform • the analyses of structural behavior of truss structures, • the design of load carrying structures as lightweight structures, • the stress calculations of truss structures under all loads in the aspect of lightweight design, • the geometrically and physically nonlinear analyses of truss structures, • the weight optimization of structures, • the interpretation of correctness of numerical simulation software and check whether the numerical results are feasible or not, • identification of engineering applications of lightweight design, develop suggestions, evaluate the obtained results and present the issues.
(Study-Specific) Prerequisites	-

(recommended) Requirements	Recommended requirements (e.g...): • Mechanics I and II • Material Science I and II • Machine Design • Advanced mathematics
References	• Hertel, H.: Leichtbau, Springer Verlag, 1960 • Wiedemann, J.: Leichtbau, Band I: Elemente, Springer Verlag, 1986 • Wiedemann, J.: Leichtbau, Band II: Konstruktion, Springer Verlag, 1989 • Czerwenka, G., Schnell, W.: Einführung in die Rechenmethoden des Leichtbaus, Band 1 und 2, BI-Hochschultaschenbücher • Roark, R. J., Young, W. C.: Formulas for Stress and Strain, McGraw-Hill, 1975 • Jones, R. M.: Mechanics of Composite Materials, McGraw-Hill, 1975 • Bruhn, E. F.: Analysis and Design of Flight Vehicles Structures • Niu, M. C. Y.: Airframe Structural Design, Conmilit Press Ltd., 1988
Language	English
Examination Terms	Written exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Kai-Uwe Schröder
ECTS Credits	4
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	120,0
Contact hours (h)	45,0
Self-study hours (h)	75,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Fundamentals of Lightweight Design (401145201)	2nd semester	no semester recommended	4	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Tutorial Fundamentals of Lightweight Design	2nd semester	no semester recommended	-	1
Lecture Fundamentals of Lightweight Design	2nd semester	no semester recommended	-	2

Module titel	Computational Fluid Dynamics I (Compulsory elective subject)
Identifier	4012278
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Introduction to CFD • Examples of flow simulatiaons • The basic PDE's of Fluid Mechanics • Different Notations • Physical meaning of characteristic lines • Determination of the type of PDE's • Characteristic form of PDE's • The basics of discretization of partial differentials • Truncation error and consistency • Solution schemes for scalar equations • Stability analysis of initial value problems • Discrete disturbance theory • von Neumann ananlysis • CFL-condition • Hirt's stability analysis • Introduction to the numerical solution of boundary value problems • Classical iterative solution methods, Jacobi, Gauß-Seidel methods • Convergence of iterative solution methods • ILU, Krylov subspace methods • Multigrid methods • Transformation of PDE's in curvlinear coordinates • Truncation error on curvelinear grids • Discretization on different unstructured meshes, solution adaptive methods • Triangle or tetrahedral based meshes • Hierarchical Cartesian meshes • Vectorization and parallelization of solution algorithms • Different applications and examples
Learning Objectives/ Learning Outcomes	• Knowledge of the partial differential equations (PDE'S) of fluid mechanics • Basics of the discretization of PDE's • Learn how to formulate numerical methods for the solution of PDE's • Ability to determine und understand the properties of truncation errors of numerical solution schemes • Understand stability and sonsistency of solution schemes • Solution of boundary value problems with iterative solution schemes • Discretization on different mesh types • Implementation of solution schemes on different computer architectures • The discussion of several examples of numerical flow simulation allows to understand different theoretical aspects in proactical mpplications
(Study-Specific) Prerequisites	-
(recommended) Requirements	recommended: • Basic knowledge in advanced mathematics • Basic knowledge in thermodynamics
References	• C.A. Fletcher: Computational Techniques for Fluid Dynamics Vol I+II, Springer Verlag, 1988

	• J.R. Anderson: Computational Fluid Dynamics, MacGraw-Hill, 1955 • C. Hirsch: Numerical Computation of Internal and External Flows, J. Wiley &; Sons, 1988 • P.J. Roache: Fundamentals of Computational Fluid Dynamics, hermosa publishers, Albuquerque
Language	English
Examination Terms	Written exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Wolfgang Schröder
ECTS Credits	4
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	120,0
Contact hours (h)	45,0
Self-study hours (h)	75,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Computational Fluid Dynamics I (401227801)	2nd semester	no semester recommended	4	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exercise Computational Fluid Dynamics I	2nd semester	no semester recommended	-	1
Lecture Computational Fluid Dynamics I	2nd semester	no semester recommended	-	2

Module titel	Production Metrology (Compulsory elective subject)
Identifier	4011467
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	Introduction • Relevance of metrology for quality assurance and its integration in production processes. Metrological Basics • Metrological concepts and definitions (Calibration, Uncertainty etc.) Tolerancing • Form and positional tolerances, tolerancing principles and basics Inspection Planning • Tasks and workflow of inspection planning, Procedure for creation of inspection plans Shop floor measuring devices/ Measuring sensors • Commonly used manual inspection devices for the shop floor, Function and application of inductive, capacitive and pneumatical sensors Optoelectronic inspection devices • Optical inspection systems for geometry testing and applications Form and surface inspection devices • Tactile and optical system for the characterisation of forms and surfaces, surfaces parameters Coordinate measurement technology • Principles, types and applications of coordinate measuring machines Gauging inspection • Form and positional gauging, Gauging Procedures Statistical basics • Statistical parameters for the description of production and measuring processes, tests on normal distribution SPC, Process Capability • Statistical analysis and control of processes, Process capability indices Inspection device management • Tasks and procedures of inspection device management, Calculation of measuring device capability, Calibration chain
Learning Objectives/ Learning Outcomes	First of all, the elements of the application of the means of measurement concerning the production are pointed out. The theoretical fundamentals which have to be taken into consideration while the measuring process is planned, controlled, analysed, are discussed. Thereby, current measuring principles and devices in the field of industrial production will be considered and new measuring techniques and trends will be presented In this context the characteristics of the measured quantities and their fringe conditions are explained. A further subject of the lecture will be the statistical analysis of the measured values.

	The aim of this lecture is to create the awareness, that “measuring” comprehends a lot more than plain data acquisition and metrology is a vital part of modern production processes.
(Study-Specific) Prerequisites	-
(recommended) Requirements	-
References	-
Language	English
Examination Terms	Written exam or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Robert Schmitt
ECTS Credits	5
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	60,0
Self-study hours (h)	90,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Production Metrology (401146701)	2nd semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Exercise Production Metrology	2nd semester	no semester recommended	-	4

Module titel	Failure of Structures and Structural Elements (Compulsory elective subject)
Identifier	4011486
Version	-
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	The course is an introduction into the most important failure theories of structures. The content is summarized as: • Recall of fundamentals in continuum mechanics • Notion of “failure” in mechanical engineering. • Geometry and deformation: strain tensors • Mechanical and thermal loading: stress tensors • Conservation laws • Material behaviour: elasticity, elasto-plasticity, hardening, damage • Anisotropy • Yield-conditions and flow rules in plasticity and visco-plasticity • Direct methods: Lower and upper bound theorems of limit analysis • Examples of application of the theorems of limit analysis • Direct methods: Lower and upper bound theorems of shakedown analysis • Examples of application of shakedown theory • Notion and concepts of fracture mechanics • Linear elastic fracture mechanics • Elastic-plastic fracture mechanics • J-integral and other path-independent integrals • Kinematic criteria • Examples of application of fracture mechanics • Use of finite element methods • Software features, examples

Learning Objectives/ Learning Outcomes	In this course, students shall acquire the following:
	
	Knowledge / Understanding:
	The students will understand:
	• the physical effects leading to failure of structures and mechanical systems. This includes:
	  • excessive elastic deformations,
	  • buckling of load carrying elements,
	  • permanent plastic deformations,
	  • material damage,
	  • initiation and propagation of cracks
	• limit and shakedown theories, failure of structures and mechanical systems under monotonic and cyclic loads and determination of corresponding load-carrying capacities
	• the phenomenon of fracture and determination of critical loads for crack propagation
	• the most important failure types and their numerical description
	
	Abilities / Skills:
	The students will be able to
	• a) determine limit loads for structures
	• b) model the phenomenon of fracture and determine critical loads for crack propagation
	• c) transfer theoretical and mathematical models to actual engineering problems and implementation into design codes

	• d) apply State-of-the-art numerical methods for the use of failure criteria in applied mechanical engineering The exercises are integrated in the lecture so that the students work individually or in groups on practical examples.
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	• Lecture Notes • J. Lemaitre, J.-L. Chaboche: Mechanics of materials, Cambridge University Press, Cambridge, 1994 • J.A. König: Shakedown of elastic-plastic structures, Elsevier, Amsterdam, 1987
Language	English
Examination Terms	Written Examination
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Bernd Markert
ECTS Credits	5
Contact time (WSH)	2
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	30,0
Self-study hours (h)	120,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Failure of Structures and Structural Elements (401148601)	2nd semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Failure of Structures and Structural Elements	2nd semester	no semester recommended	-	2

Module titel	Finite Element Methods in Lightweight Design (Compulsory elective subject)
Identifier	4011464
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	1: Introduction • Energy methods • Ritz method • General procedure of FE analysis 2: Selection criteria in Finite Element Methods • Beam elements: Shear flexible beams • Element locking • Reduced integration 3: Stability analysis • Stability behaviour of lightweight structures • Linear stability 4: Introduction to nonlinear analysis • Types of nonlinearity • Degradation/damage models • Material nonlinearity • Composites 5: Dynamic problems • Fundamental equations for dynamic problems • Solution for free vibrations (eigenvalue problems) • Modal superposition 6: Implicit and Explicit analysis • Integration in the time domain • Crash and Impact • Iteration procedures

Learning Objectives/ Learning Outcomes	After successfully completing this course, the students will have acquired the following learning outcomes: Knowledge / Understanding Students a) know the mechanical and mathematical relations used in the Finite Element Method. b) understand the structural problems to be solved and the underlying fundamentals of the solution methods that are provided by commercial codes. Skills and Competencies Students a) are able to apply the Finite Element Method in structural mechanical applications properly in order to achieve reliable numerical results for problems of lightweight design. b) · are able to analyse the structural mechanics Finite Element models according to the desired field of application, taking the assumptions of solution methods into account. · have learned to work with FE codes and to find those solutions from the software handbook that are suited best for the investigated structural problem. · are able to interpret the achieved numerical results and evaluate their correctness.
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended: • Mechanics I, II, III • Numerical Mathematics
References	· Zienkiewicz, O.C.; Taylor, R.L.:The Finite Element Method Vol. 1+2+3 McGraw-Hill · Belytschko, T; Liu, W.K., Moran, B.: Nonlinear Finite Elements for continua and Structures John Wiley LtdCrisfield, M.A.:Non-linear Finite Element Analysis of Solids and Structures Vol. 1 John Wiley Ltd · Crisfield, M.A., Non-linear Finite Element Analysis of Solids and Structures Vol. 1 John Wiley Ltd
Language	English
Examination Terms	Written exam or oral exam
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Kai-Uwe Schröder
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Finite Element Methods in Lightweight Design (401146401)	2nd semester	no semester recommended	5	0

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Tutorial Finite Element Methods in Lightweight Design	2nd semester	no semester recommended	-	1
Lecture Finite Element Methods in Lightweight Design	2nd semester	no semester recommended	-	2

Module titel	Nonlinear Structural Mechanics (Compulsory elective subject)
Identifier	4012290
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2018
Valid until	-
Module level	Master
Content	• Introduction and motivation: • Brief review of FE discretisation (solid vs. shell elements) • Brief review of linear statics and dynamics of structures • Structural nonlinearity: stress stiffening/softening, buckling, effect on nonlinear vibrations • Review of classical kinematical hypotheses (Bernoulli / Kirchhoff-Love), shortcomings, necessity of refined hypotheses • Index notation, Einstein summation convention • Kronecker symbol and associated rules • Scalar and vector product, matrix multiplication in index notation • Convected coordinates, parameter lines for a 3-D body • Co- and contravariant base vectors • Examples: cylindrical and spherical geometry • Co- and contravaiant metric tensor components • Co- and contravariant vector and tensor components • Vector product of base vectors, permutation tensor, metric tensor determinant • Surface parameter lines • Co- and contravariant surface base vectors, normal vector • Surface metric and permutation tensor • Equations of Gauss and Weingarten • Christoffel symbols • Curvature tensor of a surface • Geometrical considerations (length, area and volume elements) in the shell space, at the reference surface, at the bounding surfaces, and at the lateral boundary • Deformed configuration • Base vectors of the deformed configuration • Covariant derivative • Shifter tensor, mean and Gaussian curvature • Principle of virtual displacements • Internal and external virtual work • Definition of stresses and strains • Strain tensor for von Kármán-type nonlinearity • Strain-displacement relations for tangential, transverse shear and transverse normal strains • First-order shear deformation hypothesis • Interpretation of the kinematical variables, rotations at the reference surface • Outlook: Refined hypotheses • Nonlinear strain-displacement relations for first-order shear deformation (Reissner-Mindlin) plate and shell theory • Transition to Kirchhoff-Love plate and shell theory / Bernoulli beam theory • Internal virtual work • Internal stress resultants • Theorem of Gauss • External virtual work (surface tractions, body forces, inertia forces) • Surface load couples, boundary load couples • Body couples, inertia couples • Nonlinear equilibrium equations • Static boundary conditions

Learning Objectives/ Learning Outcomes	In this course, students shall acquire the following: Knowledge / Understanding: Students • shall know the important steps and features of consistent modeling of 2-D and 1-D structures for linear and nonlinear static and dynamic analysis. • shall be able to understand structural theories (e.g. in commercial FE-codes, in scientific publications etc.), to classify them, and to estimate the consequences of underlying hypotheses for the quality of obtainable simulation results. Abilities / Skills: Students • shall be able to analyse static and dynamic simulation results with respect to the quality of the adopted structural model. • are expected to transfer theoretical models to actual engineering problems of statically or dynamically loaded beam, plate and shell structures (e.g. arbitrary geometries, arbitrary boundary conditions, arbitrary material and ply lay-up). Competencies: Students • shall be able to critically assess the applicability, consistency and correctness of structural models. • shall be able to use their obtained knowledge in order to
(Study-Specific) Prerequisites	-
(recommended) Requirements	recommended: • Basic knowledge in mechanics (statics, strength of materials, dynamics)
References	A. H. Nayfeh, P. F. Pai: Linear and Nonlinear Structural Mechanics, Wiley-Interscience, 2004
Language	English
Examination Terms	Written exam
Miscellaneous	-
Module coordinator	apl. Prof. Dr.-Ing. Marcus Stoffel
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Nonlinear Structural Mechanics (401229001)	2nd semester	no semester recommended	5	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Vorlesung Nonlinear Structural Mechanics	2nd semester	no semester recommended	-	2
Übung Nonlinear Structural Mechanics	2nd semester	no semester recommended	-	1

Module titel	Artificial Neural Networks in Structural Mechanics (Compulsory elective subject)
Identifier	4021387
Version	V1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2021
Valid until	-
Module level	Master
Content	Classical structural mechanics is based on continuum mechanics using tensor calculus, differential geometry, and modelling of inelastic material behaviour. This theoretical approach established in the 20th century is the basis for finite element programs widely used in industry and science. Innovative approaches by means of artificial neural networks are known to be very efficient to describe complex mathematical dependencies. This effect relies on the self-learning ability of neural networks to reproduce dependencies between mechanical quantities such as stresses, strains, or other state variables. However, the neural network is based on experience and has therefore tobe trained by experimental or numerical data. Once the neural network has been trained, it is able to predict structural deformations in shorter calculation times than by using classical numerical approaches. Also the accuracy does not suffer, even though that program codes of neural networks are shorter than classical finite element codes. In order to apply the new knowledge on practical examples, the students will learn how to develop a virtual copy of the engineering structure by means of a neural network. Here, a wide variety of components in the network with different layers, neurons, activation functions etc. is available and must be ordered for the application. Special attention is focused on the combination of artificial neural networks with the finite element method. Following this approach, advantages of mesh generation and equation solvers in finite element programs are used and parts of the classical mechanical models are replaced by neural networks. E.g. material models are substituted by trained neural networks leading to shorter simulation times. Due to the fact that artificial neural networks are becoming more widespread in engineering disciplines, students will be familiar with this new trend in simulation methods after visiting this course. They will gain the competences to support the development of neural network enhanced modelling and simulation in industrial and scientific applications.
Learning Objectives/ Learning Outcomes	The aim of the course is to enable students to work with artificial neural networks from the viewpoint of engineering science. This implies to understand different network topologies and their applications in structural mechanics. Classical structural models will be replaced by artificial neural networks partly or completely depending on the current problem. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding:</u> Students: • shall understand the topology of artificial neural networks • are to gain an overview and learn motivation of network architectures (weights, bias-terms, sensilivity analysis) • are to understand different network topologies and their applications in structural mechanics • shall describe mathematical models of artificial neural networks • are to describe possible applications of artificial neural networks in structural mechanics • shall model structures enhanced by neural networks • shall program artificial neural networks • are to find solutions for differential equations approximated by neural networks • shall develop intelligent elements and know the processes behind neural network enhanced finite element simulatios

	Abilities / Skills Students: • are expected to apply artificial neural networks for numerical predictions in structural mechanics • shall program neural networks and train them by data gained from experiments or simulations • shall train artificial neural networks by means of measurement and simulation data • shall model inelastic material behaviour with artificial neural networks • are expected to apply the enhancement of finite element simulation by neural networks Competencies: Students: • shall develop intelligent elements by combining neural networks with the finite element method • are to increase the efficiency of structural calculations towards faster simulations and new structural models without material parameters trained just by experimental or simulated data • are expected to choose, depending on the current problem, whether to replace classical structural models partly or completely by artificial neural networks • shall work with artificial neural networks from the viewpoint of engineering science
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended: • Mechanik I-III • Nonlinear Structural Mechanics
References	• Lecture Notes • Empfohlene weiterführende Literatur: A. Engelbrecht, Computational lntelligence, An lntroduction, JohnWiley Literatur & Sens, Ltd, 2007.
Language	English
Examination Terms	An oral or a written exam
Miscellaneous	-
Module coordinator	Prof. Dr.-lng. Marcus Stoffel
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Prüfung Artificial Neural Networks in Structural Mechanics (402138701)	3rd semester	no semester recommended	6	-

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Artificial Neural Networks in Structural Mechanics	3rd semester	no semester recommended	-	2
Exercise Artificial Neural Networks in Structural Mechanics	3rd semester	no semester recommended	-	2

Module titel	Intelligent Monitoring of Engineering Systems (Compulsory elective subject)
Identifier	4021494
Version	V1_neu
Duration (Semester)	one semester
Cycle (Semester)	summer semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	The course curriculum consists of seminar lectures followed by a semester project. During the seminar lectures, the students will receive the necessary theoretical background to independently plan and execute the project in small groups. Consultation hours are offered to discuss challenges and problems arising during the course of the project. Finally, each group presents their achievements and results live and in form of a written report. The following topics are covered: • Sensing • Signal processing • Machine learning • Non-Destructive Testing (NDT) • Structural Health Monitoring (SHM) • Data pre- and postprocessing using MATLAB
Learning Objectives/ Learning Outcomes	In this course, students shall acquire the following: Knowledge / Understanding The students will understand • the theoretical foundations of structural health monitoring approaches in engineering • state-of-the-art and current trends in structural health monitoring • the fundamentals of sensors, filtering methods, and computational Intelligence Abilities / Skills The students are able to • describe and analyse mechanical engineering systems • extract and monitor relevant system parameters • apply fundamental methods of structural health monitoring • transfer their knowledge to new engineering applications in science and industry • independently plan, advance and complete projects
(Study-Specific) Prerequisites	-
(recommended) Requirements	Recommended: Programming experience, particularly in MATLAB (Python)
References	Farrar, C.R. and Worden, K., 2012. Structural Health Monitoring: A Machine Learning Perspective. Wiley.
Language	English
Examination Terms	Written or Oral Examination (100 %)
Miscellaneous	-

Module coordinator	Univ.-Prof. Dr.-Ing. Bernd Markert
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Intelligent Monitoring of Engineering Sys-tems (402149401)	2nd semester	no semester recommended	5	-

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture Intelligent Monitoring of Engineering Systems	2nd semester	no semester recommended	-	2
Exercise Intelligent Monitoring of Engineering Systems	2nd semester	no semester recommended	-	1

Module titel	Quality Management (Compulsory elective subject)
Identifier	4011453
Version	V2
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	The digitalization and networking of production increases the availability of data over the entire product life cycle and changes the role of quality management in relation to systems, processes and products. With the shift in focus of data analysis from reactive and corrective to proactive and predictive, the principles of quality management remain, but actors acting in quality management need new tools, e.g. from the domain of machine learning, to deal with increased complexity. The lecture deals with the interweaving of quality-related methods with the needs of a rapid situation clarification of possibly deviating processes along value chains or the associated industrial services. The orientation towards the structure of the "Internet of Production" first builds on the principles of quality management (e.g. important standards, clarification of the terms system, process and product quality). The identification of quality relevant data sources (incl. social media) along the product life cycle leads to the modelling of the data-information-knowledge pyramid. The statistical/stochastic basics serve as a fundamental basis to understand methods of data analytics and machine learning and are applied situationally to typical problem classes from different areas of quality management (e.g. process control, risk management, fault management), which are typified with regard to their structure and thus made accessible for rationalization. The goal is to increase the action competence of actors by decision support (e.g. by the use of smart devices). Contributions from practice give insight into the implementation of quality management in industry.
Learning Objectives/ Learning Outcomes	Knowledge Students shall know • Important standards and guidelines in the knowledge domain "quality management" • structure of standards (high-level structure) • System, process and product quality • Quality relevant data and data sources along the product life cycle • Statistical and methodical basics of "lndustrial lntelligence" as a core task of QM • Legal implications Understanding Students shall understand • The "Internet of Production" • The importance of quality and machine learning methods in networked adaptive production • Importance of quality and quality management in networked, adaptive production • The Classification of typical problems • basic data analytics and machine learning methods Students shall be able to apply: • Data collection (e.g. customer insights in the product development process and during product usage, data-driven procurement management) • selected data analytics and machine learning methods (e.g. for risk quantification and prediction, process control) • Quality management for services • Decision support of the "Smart Quality Expert" (e.g. predictive quality, predictive maintenance) Skills and Competencies Students

	• shall develop an understanding of the different forms of the quality concept that can be operationalized in the operational process and classify them in the sense of "Industrial Intelligence". • shall be able to identify and classify problems in the corporate context. • shall have basic knowledge in the field of machine learning, shall know corresponding advanced quality management methods and be able to describe their specific applicability and effectiveness. • shall be able to theoretically and practically penetrate applications in the quality management domain with the knowledge imparted to them as a 'tool'. • shall be able to build up the structure of an "lndustrial lntelllgence" by means of quality management methods in the corporate context, to evaluate it with regard to its effectiveness and to further develop and meaningfully link quality management methods based on an understanding of interrelationships and principles. • shall be able to intervene in value chains in an improving way based on their well-founded methodological and organizational knowledge. • shall be able to recognize and evaluate situations, strengths and weaknesses of an existing quality management system and to formulate suitable measures for a coherent further development. The contents are based on research of the Cluster of Excellence "Internet of Production". Considering this background, the participants should take the mental transformation from the application of tools (methodological competence) to the design of the underlying principles and cause-effect relationships in value chains (action competence).
(Study-Specific) Prerequisites	-
(recommended) Requirements	-none-
References	• Lecture Notes • Students also receive a list of relevant literature
Language	English
Examination Terms	Written (100 %)
Miscellaneous	-
Module coordinator	Universitätsprofessor Dr.-Ing. Robert Schmitt
ECTS Credits	6
Contact time (WSH)	4
Examination duration (min)	-
Total hours (h)	180,0
Contact hours (h)	60,0
Self-study hours (h)	120,0

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Quality Managment (401145301)	3rd semester	no semester recommended	6	0

▲Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture/Tutorial Quality Management	3rd semester	no semester recommended	-	4

Module titel	Computational Intelligence in Engineering (Compulsory elective subject)
Identifier	4021493
Version	V1_neu
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2022
Valid until	-
Module level	Master
Content	The elective course “Computational Intelligence in Engineering“ is available for students enrolled in the engineering Master programs of RWTH Aachen University. It provides an overview over recent applications of computational intelligence and deep learning that are relevant to engineering. The first half of the course content is a theoretical introduction into the topic of machine learning in engineering and programming fundamentals in Python. In the second half of the course, the students apply their gained knowledge in project-based learning. The course will be taught interactively, engaging the students using practical example projects. The following topics are covered: • Time-variant dynamic processes from simulations or experiments • Data acquisition and pre-processing • Machine learning algorithms and neural network models • Advanced neural networks architectures • Project-specific engineering problems • Programming fundamentals in Python for data-driven procedures
Learning Objectives/ Learning Outcomes	The course curriculum consists of interactive seminar lectures accompanied by semester project works. During the seminar lectures, the students will receive the necessary theoretical information and supervision to independently plan, advance and complete the projects in small groups. In addition, the seminars offer the opportunity to discuss challenges and problems arising during projects. Finally, the achievements and results obtained within the student projects will be presented by the students in the scope of the seminar lectures and the accompanying computer lab exercises. <u>Knowledge / Understanding</u> The students will understand • current trends in computational intelligence and their theoretical foundation in the context of engineering applications • the advantages of machine learning algorithms in engineering but also the limits of the methods and when better not to use them <u>Abilities / Skills:</u> The students will be able to • apply machine learning methods to a wide variety of engineering Problems • transfer their knowledge to new engineering applications in science and industry via the practical expertise gained • evaluate the merits and limitations of machine learning methods applied to computer aided engineering problems
(Study-Specific) Prerequisites	-
(recommended) Requirements	Programming experience is advantageous, preferably the language Python.
References	• Goodfellow, I., Bengio, Y., Courville, A., 2016. Deep Learning. MIT Press.

	• Keller, J.M., Liu, D., Fogel, D.B. , 2016. Fundamentals of Computational Intelligence. IEEE Press, Wiley.
Language	English
Examination Terms	Written Examination or Oral Examination (100 %)
Miscellaneous	-
Module coordinator	Univ.-Prof. Dr.-Ing. Bernd Markert
ECTS Credits	5
Contact time (WSH)	3
Examination duration (min)	-
Total hours (h)	150,0
Contact hours (h)	45,0
Self-study hours (h)	105,0

● Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Exam Computational Intelligence in Engineering (402149301)	3rd semester	no semester recommended	5	-

▲ Offer node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Lecture "Computational Intelligence in Engineering	3rd semester	no semester recommended	-	2
Exercise Computational Intelligence in Engineering	3rd semester	no semester recommended	-	1

RWTH AACHEN UNIVERSITY

+ Internship (4021269)

Module titel	Internship (Compulsory subject)
Identifier	4021269
Version	V1
Duration (Semester)	one semester
Cycle (Semester)	winter semester
Valid from	Winter semester 2019
Valid until	-
Module level	Master
Content	Internships in companies are neccessary to ensure the correct choice of the course of studies, a sufficient understandig of the technical and economic courses as well as in preparation for the professional life (also in Germany) in the future. The students should aquire knowledge about technical materials and processes used in practice corresponding economic considerations and procedures, and gain insights into social processes and structures in the companies.
Learning Objectives/ Learning Outcomes	After successfully completing this course, the students will have acquired the following learning outcomes: Knowledge / Understanding Students: • know different fields of activity in the desired occupational field • understand theoretical concepts during implementation Abilities / Skills Students: • put theory and practice in relation to each other • test their own abilities and knowledge on the basis of practical experience • follow and participate in textile engineering team meetings • eliminate misconceptions about the chosen profession Competencies Students: • assess their competences correctly • discern individual learning fields with regard to a professional activity • assess social processes and structures of companies and organisations • establish contacts with potential colleagues and employers
(Study-Specific) Prerequisites	-
(recommended) Requirements	none
References	-
Language	German/English
Examination Terms	Praktikumsbericht, unbenotet
Miscellaneous	-
Module coordinator	-
ECTS Credits	12
Contact time (WSH)	-
Examination duration (min)	-

+ Internship (4021269)

Total hours (h)	360,0
Contact hours (h)	-
Self-study hours (h)	-

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Examination Internship (402126901)	3rd semester	no semester recommended	12	-

RWTH AACHEN UNIVERSITY

+ Master Thesis (4014496)

Module titel	Master Thesis (Compulsory subject)
Identifier	4014496
Version	Angelegt über RWTH API als 1
Duration (Semester)	one semester
Cycle (Semester)	winter/summer semester
Valid from	Summer semester 2013
Valid until	-
Module level	Master
Content	Completed academic paper which shall show that the students are capable of independently processing a problem related to their subject according to academic methods within a set deadline.
Learning Objectives/ Learning Outcomes	The students learn the independent approach and processing of academic themes, their documentation and written interpretation within a set deadline. They aquire systematic academic research.
(Study-Specific) Prerequisites	The topic of the Master's thesis cannot be assigned until 45 CPs have been achieved. Reasonable excep-tions are governed by the Board of Examiners upon request by the candidate.
(recommended) Requirements	Mandatory: • Industrial internship • Mini Thesis • 92 ECTS
References	-
Language	English
Examination Terms	• Written academic paper and • Colloquium of 30 minutes
Miscellaneous	-
Module coordinator	-
ECTS Credits	30
Contact time (WSH)	0
Examination duration (min)	-
Total hours (h)	900,0
Contact hours (h)	,0
Self-study hours (h)	900,0

+ Master Thesis (4014496)

Exam node

Title	Recommended Semester (Study start winter)	Recommended Semester (Study start summer)	ECTS Credits	Contact time (WSH)
Master Thesis & Master Thesis colloquium (401449601)	4th semester	no semester recommended	30	0