Module Handbook

‘Management and Engineering in Structural Engineering and Risk Management of Industrial Facilities’ (M.Sc.)

Table of Contents

Compulsory Courses – Engineering

First Term (Winter Semester)

RWTH Aachen (Faculty 3 – Civil Engineering and Faculty 4 – Mechanical Engineering)

Module: Structural Analysis and Computational Methods I

Module	Structural Analysis and Computational Methods I
Module level	Master
Subtitle	SACM I
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Lecturer	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Structural Analysis and Computational Methods I** *Overall goal: This course deals with plates and shells and provides the basic linear theory for the structural analysis. It presents the basics and fundamentals of the finite element method and gives an overview of modern finite element technology. The finite element modelling is discussed within plate and shell examples, which are typical construction elements in industrial facilities. The attendees will attain deep knowledge in the finite element method for plates and shells and they gain the necessary skills to analyse industrial components.*

	After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • know and understand structural analysis for plate and shell structural elements; • have a deep understanding of fundamental principles in computational structural analysis. <u>Abilities / Skills</u> Students • apply the knowledge for the static analysis of plates and shells; • classify numerical finite element simulations. <u>Competencies</u> Students • critically assess the results of commercial finite element software; • have learned the specifics of plates and shells and their different load carrying character.
Content	**Structural Analysis and Computational Methods I** **Structural Analysis** • The different concepts of plate and shells with respect to their load carrying character • Plain shells governing equations for linear elasticity • Different methods for solving the partial differential equation. • Plates governing equations for linear elasticity • Different methods to solve the partial differential equation. **Computational Method** • Modelling with finite elements: strengths and weaknesses. • Fundamentals of the finite element method. • Displacement formulation • Mixed formulation • Locking effects and their treatment
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes, Slides Students also receive a list of relevant literature

Lectures / Examinations					
Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Structural Analysis and Computational Methods I		5	0	0	90
Lecture: Structural Analysis and Computational Methods I		0	2	45	0
Exercise: Structural Analysis and Computational Methods I		0	2	45	0

Teaching Unit / Examinations: Examination Structural Analysis and Computational Methods I	
Title	Examination
Sub-title	Exa SACM I
Semester	1
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Structural Analysis and Computational Methods I	
Title	Lecture Structural Analysis and Computational Methods I
Sub-title	L SACM I
Semester	1
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Exercise Structural Analysis and Computational Methods I	
Title	Exercise Structural Analysis and Computational Methods I
Sub-title	E SACM I
Semester	1
Connection to the curriculum	Compulsory Module

Module: Steel Structures in Industrial Applications

Module	Steel Structures in Industrial Applications
Module level	Master
Subtitle	SSIA
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Dr.-Ing. Markus Feldmann
Lecturer	Univ.-Prof. Dr.-Ing. Markus Feldmann
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise (Homework)
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	Required qualification to attend the examination: passed homework
Learning objectives	**Steel Structures in Industrial Applications** After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • understand the importance of fatigue, fracture mechanics and toughness with respect to well-established limit states in structural steel design; • are familiar with steel (sub-)structures that are commonly used for industrial application. <u>Abilities / Skills</u> Students

	• perform beam analysis including stability problems and 2nd order theory; • make use of energetic methods to determine the maximum load capacity of structures. <u>Competencies</u> Students • recapitulate the basics of structural steel design in civil engineering (mechanical behaviour of mild steel, cross section classifications/checks, design of connections); • Assess the buckling resistance of rectangular plates under longitudinal and shear stresses.
Content	**Steel Structures in Industrial Applications** 1. Basics I: (Material behaviour of structural steel and basic safety/design principles of Eurocodes, Cross section classification and elastic/plastic cross section checks) 2. Basics II: (Connections: Bolted/Welded) 3. 2nd order theory, Buckling analysis of beams (basic stability problems) 4. Theory of plastic limit analysis 5. Analysis and design of simple industrial steel structures (moment resisting frames, braced frames, truss girders, stages, …) 6. ULS based on fracture mechanics (basic concepts), Fatigue resistance and toughness 7. Stability of shells and plates according to Eurocode 3
Media	e-Learning L²P, Power Point
Literature	Students receive a list of relevant literature, e.g.: • Lecture notes • Exercise hand-outs • DIN- / EN-Standards (e.g. DIN EN 1993-1-1) • Roik, K.: Vorlesung über Stahlbau Grundlagen, Berlin: Ernst & Sohn Verlag, 1983 • Petersen, C. Stahlbau / Grundlagen der Berechnung und baulichen Ausbildung von Stahlbauten, Braunschweig: Vieweg Verlag, 1988

Lectures / Examinations

Title	Code	ECTS	Workload (SWS / h)		Duration of Exam (min)
			Lecture h. (SWS)	Self-Study (h)	
Examination: Steel Structures in Industrial Applications		5	0	0	75

Lecture: Steel Structures in Industrial Applications		0	2	30	0
Exercise (Homework): Steel Structures in Industrial Applications		0	2	60	0

Teaching Unit / Examinations: Examination Steel Structures in Industrial Applications	
Title	Examination Steel Structures in Industrial Applications
Sub-title	Exa SSIA
Semester	1
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Lecture Steel Structures in Industrial Applications	
Title	Lecture Steel Structures in Industrial Applications
Sub-title	L SSIA
Semester	1
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise (Homework) Steel Structures in Industrial Applications	
Title	Exercise (Homework) Steel Structures in Industrial Applications
Sub-title	E SSIA
Semester	1
Connection to the curriculum	Compulsory Module

Module: Structural Dynamics

Module	Structural Dynamics
Module level	Master
Subtitle	SD
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Lecturer	Dr.-Ing. Okyay Altay
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	Homework (30 h); grading: ungraded, weighting: 0 %; written examination (75 min) (or oral examination), grading: graded, weighting: 100 %.
Learning objectives	**Structural Dynamics** *Overall goal: Students become familiar with the fundamentals of analytical and numerical methods to investigate the dynamic behaviour of civil engineering structures.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • understand how to discretize structures and identify dynamic loads; • get a detailed information about the calculation methods; • know the basics about nonlinear systems, damping models and random vibrations.

	Abilities / Skills Students • use time and frequency domain based calculation methods; • use computational methods to investigate the design of structures under dynamic loading. Competencies Students • calculate the dynamic response of structures; • identify the natural frequencies and mode shapes of structures.
Content	**Structural Dynamics** • Single-degree-of-freedom systems • Multi-degree-of-freedom systems • Systems with distributed mass and stiffness • Frequency domain methods • Time domain methods • Nonlinear systems • Damping models • Random vibrations
Media	e-Learning L^2P, Power Point
Literature	Lecture Notes A. K. Chopra: Dynamics of Structures, Prentice Hall, 2012. R. W. Clough, J. Penzien: Dynamics of Structures, Computers & Structure Inc., 2003. J. Humar: Dynamics of Structures, CRC Press, 2012. K. Meskouris: Structural Dynamics - Models, Methods, Examples, Ernst, 2000. M. Paz, W. Leigh: Structural Dynamics, Springer, 2004.

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Structural Dynamics		5	0	0	60

Lecture: Structural Dynamics		0	2	45	0
Exercise: Structural Dynamics		0	2	45	0
Teaching Unit / Examinations: Examination Structural Dynamics					
Title	Examination Structural Dynamics				
Sub-title	Exa SD				
Semester	1				
Connection to the curriculum	Compulsory Module				
Teaching Unit / Examinations: Lecture Structural Dynamics					
Title	Lecture Structural Dynamics				
Sub-title	L SD				
Semester	1				
Connection to the curriculum	Compulsory Module				
Teaching Unit / Examinations: Exercise Structural Dynamics					
Title	Exercise Structural Dynamics				
Sub-title	E SD				
Semester	1				
Connection to the curriculum	Compulsory Module				

Module: Individualized Construction

Module	Individualized Construction
Module level	Master
Subtitle	IC
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Dr. techn. Sigrid Brell-Cokcan
Lecturer	Univ.-Prof. Dr. techn. Sigrid Brell-Cokcan
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written or oral examination, Lecture, Exercises
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Individualized Construction** *Overall goal: Students gain theoretical knowledge regarding the individualization of buildings as well as the associated production and construction processes. They learn to apply a variety of integrated design methods and process development strategies relevant to the construction sector.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • know and understand aspects of production processes in the building sector; • know and understand criteria of construction procedures;

	• know and understand the interaction of building design and production criterial; • know and understand influence of individualization on production procedures and building design. <u>Abilities / Skills</u> Students • apply process planning methods for the construction sector; • analyse and optimize building designs according to production aspects and vice versa. <u>Competencies</u> Students • communicate conflicting aspects of production and design within an interdisciplinary planning team.
Content	**Individualized Construction** The course provides theoretical and practical knowledge in relevant technologies and planning methods for the development of individualized building production and construction processes. This includes the examination of strategies for handling conflicting demands of individualized building design and production aspects. The course starts out with a lecture series on relevant production aspects such as: - current building production processes - current machinery and technology in building production - aspects of material processing - aspects of construction details for production and assembly - intelligent penalization & modularization of buildings and building elements - aspects of individualization for process and design planning Afterwards, the taught topics will be practically applied by developing or optimizing either a building design or building construction process within an interdisciplinary team.
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes, Slides Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	

Examination: Individualized Construction		5	0	0	90
Lecture: Individualized Construction		0	2	45	0
Exercise: Individualized Construction		0	2	45	0

Teaching Unit / Examinations: Examination Individualized Construction	
Title	Examination Individualized Construction
Sub-title	Exa IC
Semester	1
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Lecture Individualized Construction	
Title	Lecture Individualized Construction
Sub-title	L IC
Semester	1
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise Individualized Construction	
Title	Exercise Individualized Construction
Sub-title	E IC
Semester	1
Connection to the curriculum	Compulsory Module

Elective Courses – Engineering

First Term (Winter Semester)

RWTH Aachen (Faculty 3 – Civil Engineering and Faculty 4 – Mechanical Engineering)

Module: Structural Control and Health Monitoring

Module	Structural Control and Health Monitoring
Module level	Master
Subtitle	SCHM
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Lecturer	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Written examination, Lecture
Workload	Total 90h, Lecture hours 30h, Self-study 60h
Lecture hours	30h
ECTS-Credit Points (CP)	3
Requirements according to examination regulation	-none-
Learning objectives	**Structural Control and Health Monitoring** *Overall goal:* *This course gives the attendees a comprehensive overview of the latest developments of this highly innovative and interdisciplinary research field of structural control and health monitoring systems for important civil engineering structures.* *The course provides students with a useful tool set for the analytic, numeric and experimental design of these systems.*

	At the end of the course, the students gain the necessary skills for the implementation of structural control and health monitoring systems on high-rise buildings and other important civil infrastructure, such as bridges. After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • understand using which methods the structural vibrations can be controlled; • know the basic principles about the sensor systems to monitor the condition of a structure. <u>Abilities / Skills</u> Students • use calculation methods to calculate the dynamic response of a structure with control devices; • use sensors and computational methods to identify the parameters and conditions of a structure. <u>Competencies</u> Students • design structural control and monitoring systems.
Content	**Structural Control and Health Monitoring** **Structural Control** • Structural rehabilitation and retrofitting • Passive, active and semi-active damper systems • Anti-seismic devices • Principles of control engineering **Structural Health Monitroing** • Sensor and actuator technology • Signal processing • System identification methods • Vibration measurement and evaluation • Condition monitoring
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes

	Adams D E (2007): Health Monitoring of Structural Materials and Components, Wiley, ISBN 978-0-470-03313-5. Casciati F, Magonette G, Marazzi F (2006): Technology of Semiactive Devices and Applications in Vibration Mitigation, Wiley, ISBN 978-0-470-02289-4. Constantinou M C, Soong T T, Dargush G F (1998): Passive Energy Dissipation Systems for Structural Design and Retrofit, MCEER, ISBN 0-9656682-1-5. Hanson R D, Soong T T (2001): Seismic Design with Supplemental Energy Dissipation Devices, EERI, ISBN 0-943198-13-5. Karbhari V M, Ansari F (2009): Structural Health Monitoring of Civil Infrastructure Systems, Elsevier, ISBN 978-1-84569-392-3. Soong T T, Constantinou M C (1994): Passive and Active Structural Vibration Control in Civil Engineering, Springer, ISBN 3-211-82615-7. Soong T T, Dargush G F (1997): Passive Energy Dissipation Systems in Structural Engineering, Wiley, ISBN 978-0-471-96821-4.

Lectures / Examinations

Title	Code	ECTS	Workload (SWS / h)		Duration of Exam (min)
			Lecture h. (SWS)	Self-Study (h)	
Examination: Structural Control and Health Monitoring		3	0	0	60
Lecture: Structural Control and Health Monitoring		0	2	60	0

Teaching Unit / Examinations: Examination Structural Control and Health Monitoring

Title	Examination Structural Control and Health Monitoring
Sub-title	Exa SCHM
Semester	1
Connection to the curriculum	Elective Module

Teaching Unit / Examinations: Lecture Structural Control and Health Monitoring

Title	Lecture Structural Control and Health Monitoring
Sub-title	L SCHM
Semester	1

Connection to the curriculum	Elective Module

Module: Structural Analysis and Computational Methods II

Module	Structural Analysis & Computational Methods II
Module level	Master
Subtitle	SACM II
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Lecturer	Univ.-Prof. Dr.-Ing. habil. Sven Klinkel
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 90h, Lecture hours 45h, Self-study 45h
Lecture hours	45h
ECTS-Credit Points (CP)	3
Requirements according to examination regulation	Successful completion of the module 'Structural Analysis and Computational Methods I'
Learning objectives	**Structural Analysis and Computational Methods II** *Overall goal: This course deals with plates and shells and provides the basic linear theory for the structural analysis.* *It presents the basics and fundamentals of the finite element method and gives an overview of modern finite element technology.* *The finite element modelling is discussed within plate and shell examples, which are typical construction elements in industrial facilities.* *The attendees will attain deep knowledge in the finite element method for plates and shells and they gain the necessary skills to analyse industrial components.* After successfully completing this course, the students will have acquired the following learning outcomes

	Knowledge / Understanding Students • know and understand structural analysis for plate and shell structural elements; • have a deep understanding of fundamental principles in computational structural analysis; • have learned the specifics of plates and shells and their different load carrying character. Abilities / Skills Students • apply the knowledge for the static analysis of plates and shells; • classify numerical finite element simulations. Competencies Students • critically assess the results of commercial finite element software. • Have learned the specifics of plates and shells and their different load carrying character.
Content	**Structural Analysis and Computational Methods II** Nonlinear structural analysis in the context of large deformations; it is focused on spatial structures like beams and shells; in particular the Reissner beam and a five parameter shell formulation are derived; large rotations and displacements are considered; for the solution of the boundary value problem the Finite-Element-Method is employed; all necessary matrices for implementation are provided.
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes, Slides Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Structural Analysis and Computational Methods II		3	0	0	60-120

Lecture: Structural Analysis and Computational Methods II		0	2	30	0
Exercise: Structural Analysis and Computational Methods II		0	1	15	0

Teaching Unit / Examinations: Examination Structural Analysis and Computational Methods II	
Title	Examination Structural Analysis and Computational Methods II
Sub-title	Exa SACM II
Semester	1
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Lecture Structural Analysis and Computational Methods II	
Title	Lecture Structural Analysis and Computational Methods II
Sub-title	L SACM II
Semester	1
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Exercise Structural Analysis and Computational Methods II	
Title	Exercise Structural Analysis and Computational Methods II
Sub-title	E SACM II
Semester	1
Connection to the curriculum	Elective Module

Compulsory Course – Management

First Term (Winter Semester)

RWTH Aachen (Faculty 8 – School of Business and Economics)

Module: Strategic Technology Management

Module	Entrepreneurial Strategy
Module level	Master
Subtitle	STM
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	Univ.-Prof. Torsten-Oliver Salge, Ph. D.
Lecturer	Univ.-Prof. Torsten-Oliver Salge, Ph. D.
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	The course grade will be determined based on one of the following modes of evaluation: (a) Colloquium and presentation (50%) and written exam (50%, duration: 60 minutes); or (b) Colloquium and presenation (50%) and written (individual) term paper (50%); or (c) Written exam (100%, duration: 60 minutes) The final mode of evaluation (A, B, or C) will be announced and publicly displayed prior to the first class session. In general, grading for this class will be based on mode (a).
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Strategic Technology Management**

	Overall goal: Students gain theoretical and practical knowledge in technology and innovation management as preparation for interdisciplinary leadership roles in research and development (R&D) and beyond. After successfully completing this course, the student will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • understand and critically reflect upon key concepts and theories in strategic TIM; • understand and critically discuss conceptual and empirical research papers on strategic TIM. <u>Abilities / Skills:</u> Student: • analyze and develop adequate solutions to some of the practical challenges of strategic TIM; • apply important tools in strategic TIM intelligently based on a thorough understanding of their respective strengths and weaknesses.

Content	**Strategic Technology Management**
	
	• This course provides a case- and/or research-based introduction to strategic technology and innovation management (TIM)
	• This involves revisiting some of the foundational concepts and debates in strategic management and examining key strategic decisions at the heart of technology and innovation management
	• These might pertain for instance to
	  • the selection of technology fields,
	  • the composition of innovation portfolios,
	  • the timing of technology development initiatives,
	  • the development of innovation processes,
	  • the search for new ideas,
	  • the involvement of users,
	  • the implementation of modular designs,
	  • the orchestration of strategic alliances,
	  • the protection of intellectual property.
	• As part of this course, participants will have the opportunity to become familiar with case studies and/or research papers related to these topics.
	• The course is typically composed of six longer classroom sessions comprising a mixture of traditional lectures, case/paper discussions and student presentations.

	• Please note, that a detailed course outline and reading list will be made available ahead of the first session
Media	e-Learning L²P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Strategic Technology Management		5	0	0	See examination options
Lecture: Strategic Technology Management		0	2	45	0
Exercise: Strategic Technology Management		0	2	45	0

Teaching Unit / Examinations: Examination Strategic Technology Management

Title	Examination Strategic Technology Management
Sub-title	Exa STM
Semester	1
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Strategic Technology Management

Title	Lecture Strategic Technology Management
Sub-title	L STM
Semester	1
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Exercise Strategic Technology Management

Title	Exercise Strategic Technology Management
Sub-title	E STM

Semester	1
Connection to the curriculum	Compulsory Module

Compulsory Course – German Language Course

First Term (Winter Semester)

RWTH Aachen (Language Centre)

Module: German Language Course

Module	German Language Course
Module level	Master
Subtitle	GLC
Lecture	See list of lectures and examinations of the module
Semester	1
Person in charge	-
Lecturer	-
Language	German
Assignment to the curriculum	Compulsory Module
Teaching form	Workshops to teach skills, with practice sessions; Self-study, Group exercises; Action-learning, based on role-plays, simulations and behavioural exercises Grading Options: a) Written exam (60-120 min., graded, 100%) or oral exam (15-45 min., graded, 100%) b) Written exam (60-120 min., graded, 50%) and oral exam (15-45 min., graded, 50%)
Workload	Total 60h, Lecture hours 30h, Self-study 30h
Lecture hours	30h
ECTS-Credit Points (CP)	2
Requirements according to examination regulation	-none-
Learning objectives	**German Language Course**

	After successfully completing this course, the students will have acquired the following learning outcomes: <u>Abilities / Skills</u> Students • communicate basic knowledge • on German Culture and Cultural Studies; • accomplish everyday • communication within university surroundings • (dormitory, cafeteria etc.); • offer prerequisites for culturally • adequate application documents for internships • (CV, letter of motivation).
Content	**German Language Course** • Getting to know someone • Introducing oneself • City explorations • Orientation in the city • Techniques: learning and remembering words • Buying groceries • Communication on the phone • Techniques: learning grammar systematically • Calendar, festivities • Holidays • Learning and forgetting • Learning psychology • German newspapers • Reading habits • When in Rome, do as the Romans do • Intercultural experience • Media • Geographic German studies • Inventions and progress • Between cultures • Environmental protection/problems • Project Europe

	• Job market Germany • Applications • CVs
Media	e-Learning L²P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Teaching Unit / Examinations:

Title	**Code**	**Credit Points**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: German Language Course		2	0	0	See examination options
Lecture: German Language Course		0	1	15	0
Exercise: German Language Course		0	1	15	0

Teaching Unit / Examinations: Examination German Language Course

Title	Examination German Language Course
Sub-title	Exa GLC
Semester	1
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture/Exercise German Language Course

Title	Lecture/Exercise German Language Course
Sub-title	L/E GLC
Semester	1
Connection to the curriculum	Compulsory Module

Compulsory Courses – Engineering
Second Term (Summer Semester)
RWTH Aachen (Faculty 3 – Civil Engineering)

Module: Factory Planning

Module	Factory Planning
Module level	Master
Subtitle	FaPl
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	Univ.-Prof. Dr.-Ing. Achim Kampker,
Lecturer	Univ.-Prof. Dr.-Ing. Achim Kampker, Dr.-Ing. Peter Burggräf
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Factory Planning** *Overall goal: Dear factory planer, design a factory which can produce watches today and cars tomorrow, that can produce different volumes each day, which is inflatable and transportable (Helmut Schulte).* *The global competition, wide production programmes und frequent discontinuities lead to so far unknown challenges for the planning process of factories. Besides the classical resource, layout and logistic planning,*

	also 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, are part of the process. *The lecture factory planning shows the state of the art of the particular topics, best-practice methods and approaches are explained and reference solutions presented. The theoretical content is deepened by an accompanying case-study and the presentation of actual industrial factory planning projects.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • 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. <u>Abilities / Skills</u> Students • apply this knowledge to analyse organizational structures and forms of production. <u>Competencies</u> Students • define and develop single production plants as well as production networks of globalized companies and explain them to different target groups.
Content	**Factory Planning** **L1/L2 - Introduction** • Comprehending the basic glossary, getting to know the content and understanding the challenges and requirements of modern factory planning. **L3/L4 - Dimensions of added value in Production / Evaluation methods for the planning process of value added** • Getting to know different categories of value added in factory planning as well as strategic and economic methods for their evaluation

	L5/L6 - Production site planning • This lecture focusses on current trends within the field of production site planning and presents methods for the assessment of production site alternatives and decision-making **L7/8 – Production Systems I: Process Planning and Resource Planning** • Learning about challenges and approaches within the production process planning, understanding the problem of capacity planning in manufacturing and human resources **L9/10 - Production Systems II: Organization and Lean Production** • Introduction to different organizational structures and forms of production, comprehending lean production with its basic elements and understanding the implementation of lean principles into production systems **L11/12 - Logistics planning** • Comprehend the basics of logistics planning, getting to know the development of logistic strategies and principles from sourcing to recycling processes **L13/L14 - Layout and factory structure planning** • Introduction to challenges and targets of layout and factory structure planning. Acquiring knowledge of design and assessment of factory layouts
Media	e-Learning L^{2}P, Power Point, group work
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Factory Planning		5	0	0	120
Lecture: Factory Planning		0	2	45	0
Exercise: Factory Planning		0	2	45	0

Teaching Unit / Examinations: Examination Factory Planning	
Title	Examination Factory Planning
Sub-title	Exa FaPl
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Lecture Factory Planning	
Title	Lecture Factory Planning
Sub-title	L FaPl
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise Factory Planning	
Title	Exercise Factory Planning
Sub-title	E FaPl
Semester	2
Connection to the curriculum	Compulsory Module

Module: Introduction to Soil Mechanics and Dynamics

Module	Introduction to Soil Mechanics and Dynamics
Module level	Master
Subtitle	ISMD
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	Univ.-Prof. Dr.-Ing. Martin Ziegler
Lecturer	Univ.-Prof. Dr.-Ing. Martin Ziegler
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Introduction to Soil Mechanics and Dynamics** *Overall goal: Students gain the basic knowledge about soil mechanics and dynamics and their application in geotechnical design.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • are familiar with the fundamental concepts of soil mechanics; • understand the difference between static and dynamic design in geotechnics; • know the possibilities of numerical applications in soil dynamics. <u>Abilities / Skills</u> Students • determine and apply appropriate design concepts and soil parameters in soil dynamics.

	Competencies Students • have an overview of the influence of dynamic loads in geotechnical engineering; • find practical solutions for design problems related to soil dynamics.
Content	**Introduction to Soil Mechanics and Dynamics** • General introduction to Soil Mechanics (Laboratory tests, soil and water, shear strength) • Wave Propagation in Soil • Dynamic Soil Parameters (Constitutive Laws, Soil Damping, Laboratory and Field Tests) • Vibrations in Soil (Vibration Sources, Vibration Propagation in Soil, Evaluation and Design Concepts, Vibration Isolation Measures) • Seismic design of raft foundations (Introduction to static design concept, Seismic design concept) • Seismic design of earth retaining structures (Introduction to static design concept, Seismic design concept) • Numerical Applications
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Introduction to Soil Mechanics and Dynamics		5	0	0	90
Lecture: Introduction to Soil Mechanics and Dynamics		0	2	45	0
Exercise: Introduction to Soil Mechanics and Dynamics		0	2	45	0

Teaching Unit / Examinations: Examination Introduction to Soil Mechanics and Dynamics

Title	Examination Introduction to Soil Mechanics and Dynamics
Sub-title	Exa ISMD
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Introduction to Soil Mechanics and Dynamics	
Title	Lecture Introduction to Soil Mechanics and Dynamics
Sub-title	L ISMD
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Introduction to Soil Mechanics and Dynamics	
Title	Exercise Introduction to Soil Mechanics and Dynamics
Sub-title	E ISMD
Semester	2
Connection to the curriculum	Compulsory Module

Module: Design of Concrete Structures for Industrial Facilities

Module	Design of Concrete Structures for Industrial Facilities
Module level	Master
Subtitle	DCSIF
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	Univ.-Prof. Dr.-Ing. Josef Hegger
Lecturer	Univ.-Prof. Dr.-Ing. Josef Hegger
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise (Homework)
Workload	Total 150h, Lecture hours 45h, Self-study 105h
Lecture hours	45h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	Exam requirements: Passing the homework assignments
Learning objectives	**Design of Concrete Structures for Industrial Facilities** *Overall goal: Students gain the basic knowledge about the design of concrete structures within the scope of industrial facilities* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • have a general understanding of the safety concept for the design according to Eurocode; • know the basic concepts designing with reinforced concrete; • understand the characteristics of concrete design for industrial facilities;

	• understand the interaction between different civil engineering disciplines regarding connections and structural stability as well as Mechanical, Electrical and Piping (MEP) works and architecture regarding e.g. corridors for installations. <u>Abilities / Skills</u> Students • calculate loads and forces in for concrete structures; • perform a preliminary design of concrete structures according to EC2; • design concrete connection details for non-structural and structural industrial components; • design reinforced concrete bracing structures. <u>Competencies</u> Students • assess the advantages and disadvantages of using reinforced concrete for industrial facilities; • distinguish the field of application for concrete (vs. structural steel); • design solutions for safe, reliable and economic load transfer with reinforced concrete.
Content	**Design of Concrete Structures for Industrial Facilities** **<u>General</u>** • General introduction to the course and the use of reinforced concrete for the construction of industrial facilities • Overview of different types of structural elements made of reinforced concrete typically (and economically) used in industrial facilities • Revision of load assumptions for design of concrete structures (live load, dead load, lateral loads induced by wind, accidental loads or earthquakes) and the safety concept for design according to Eurocode • Revision of basic material properties of reinforcement steel and concrete • Revision of basic design principles for the composite material reinforced concrete such as design for bending and shear • Foundations, Machine Foundations • Shear walls and bracings. Openings for installations • Serviceability Limit State and crack width. Industrial concrete flooring • Basics of precast and prestressed concrete construction • Silos and tanks

	• Design of connections to concrete structures (built-in-plates, welding plates, anchors, chemical dowels) for structural steel and non-structural industrial parts • Firewalls and material resistance of reinforced concrete exposed to fire • Accidental loads, impact an progressive collapse design • Earthquake-resistant design of concrete structures • Repetitorium **Homework Assignment** Application of the taught content to simple design problems with direct applicability in the scope of design of concrete structures for industrial facilities. Students work independently in order to deepen their understanding and proof their ability to adapt known concepts and techniques to new problems. The homework assignment will be handed out during and prepared parallel to the course of the session. The successful completion of the homework assignment is required to participate in the written or oral examination at the end of the semester.
Media	e-Learning L^2P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Design of Concrete Structures for Industrial Facilities		5	0	0	60
Lecture: Design of Concrete Structures for Industrial Facilities		0	2	45	0
Exercise (Homework): Design of Concrete Structures for Industrial Facilities		0	1	60	0

Teaching Unit / Examinations: Examination Design of Concrete Structures for Industrial Facilities

Title	Examination Design of Concrete Structures for Industrial Facilities
Sub-title	Exa DCSIF
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Lecture Design of Concrete Structures for Industrial Facilities	
Title	Lecture Design of Concrete Structures for Industrial Facilities
Sub-title	L DCSIF
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise (Homework) Design of Concrete Structures for Industrial Facilities	
Title	Exercise (Homework) Design of Concrete Structures for Industrial Facilities
Sub-title	E DCSIF
Semester	2
Connection to the curriculum	Compulsory Module

Module: Design and Detailing of Non-Structural Industrial Components and Equipment

Module	Design and Detailing of Non-Structural Industrial Components and Equipment
Module level	Master
Subtitle	DDNICE
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	apl. Prof. Dr.-Ing. Benno Hoffmeister, Prof. Dr.-Ing. Christoph Butenweg
Lecturer	apl. Prof. Dr.-Ing. Benno Hoffmeister, Prof. Dr.-Ing. Christoph Butenweg
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise (Homework)
Workload	Total 150h, Lecture hours 45h, Self-study 105h
Lecture hours	45h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	Exam requirements: Passing the homework assignments
Learning objectives	**Design and Detailing of Non-Structural Industrial Components and Equipment** After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • know how to categorise different types of non-structural industrial components and equipment as well as specific constructional details; • understand the basic material requirements and characteristics for different types of components/equipment; • understand the basic design principles for typical non-structural industrial components and equipment;

	• know which international standards are applied in practice for different types of components/equipment. Abilities / Skills Students • use international standards for the basic design of typical non-structural industrial components and equipment; • develop a concept for the integration of non-structural elements into structures (considering interaction, anchorages, supports,…). Competencies Students • identify possible sources of structural interaction between multiple components and structures; • identify the relevant loads to be considered in the design; • use their knowledge to assess the suitability of different detailing options considering given requirements and conditions.
Content	**Design and Detailing of Non-Structural Industrial Components and Equipment** 1. Topology of industrial facilities, based on general process engineering 2. Design and detailing of typical non-structural components and equipment with the emphasis on: a) Pressurised Vessels - Materials suitable for pressurised vessels design - Classification of pressuried vessels (hor. cylindrical, vert. cylindrical, spherical) - Design and analysis acc. to international standards (AD2000, EN 13445, ASME VIII Div. 1/2) including vessel shell, heads, saddles/skirts, nozzles, ring stiffeners,… - Construction and assembly of pressure vessels b) Piping systems - Materials suitable for design of pipes - Design of pipes acc. to international standards EN13480, EN 1993-4-2 and ASME B31.3 including Elbows, welded joints, bolted flange joints, gaskets, valves, supports - Expansion bends, compensators c) Tanks and Silos - Materials suitable for design of tanks and silos - Classification of tanks and silos - Design of tanks acc. to international standards API 620/650, EN 14015, EN 1993-4-2 including single/multi ply tank shells, base plates, (floating) roofs, nozzles, stiffening rings, anchorages,…

	- Design of silos acc. to international standards including EN 1993-4-1 d) <u>Other process equipment</u> - Distillation columns - Vaporizer - Heater - Chimneys - Reactors Structural interaction between multiple components of different kind
Media	e-Learning L²P, Power Point
Literature	Students receive a list of relevant literature, e.g.: • Lecture notes • Students will receive a list of relevant literature/standards

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Design and Detailing of Non-Structural Industrial Components and Equipment		5	0	0	60-120
Lecture: Design and Detailing of Non-Structural Industrial Components and Equipment		0	2	45	0
Exercise (Homework): Design and Detailing of Non-Structural Industrial Components and Equipment		0	1	60	0

Teaching Unit / Examinations: Examination Design and Detailing of Non-Structural Industrial Components and Equipment

Title	Exam Design and Detailing of Non-Structural Industrial Components and Equipment
Sub-title	Exa DDNICE
Semester	2
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Design and Detailing of Non-Structural Industrial Components and Equipment	
Title	Lecture Design and Detailing of Non-Structural Industrial Components and Equipment
Sub-title	L DDNICE
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise (Homework) Design and Detailing of Non-Structural Industrial Components and Equipment	
Title	Exercise (Homework) Design and Detailing of Non-Structural Industrial Components and Equipment
Sub-title	E DDNICE
Semester	2
Connection to the curriculum	Compulsory Module

Elective Courses – Engineering

Second Term (Summer Semester)

RWTH Aachen (Faculty 3 – Civil Engineering and Faculty 4 – Mechanical Engineering)

Module: Mechanics of Engineering Materials

Module	Mechanics of Engineering Materials
Module level	Master
Subtitle	MEM
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	Univ.-Prof. Dr.-Ing. Stefanie Reese, Dr.-Ing. Jaan-Willem Simon
Lecturer	Univ.-Prof. Dr.-Ing. Stefanie Reese, Dr.-Ing. Jaan-Willem Simon
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture Hours 45h, Self-study 105h
Lecture hours	45h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Mechanics of Engineering Materials** *Overall goal: Students gain theoretical and practical knowledge in mechanics of engineering materials.* After successfully completing this course, the students will have acquired the following learning outcomes:

	Knowledge / Understanding Students • know the different phenomena which can be observed in experiments; • know the different material models which have been proposed to describe these phenomena; • understand the basic concept of how to achieve an appropriate material model. Abilities / Skills Students • analyse analytical and numerical results with respect to the quality of the adopted model; • predict the material response to a given loading scenario. Competencies Students • critically assess the applicability and correctness of material models; • transfer theoretical models to actual engineering problems from the fields of mechanical, civil, and aeronautical engineering.
Content	**Mechanics of Engineering Materials** The course aims at the understanding of the behaviour of engineering materials such as metals, plastics, and carbon fibre-reinforced composites. The major objective is the development and discussion of appropriate material models for elastic and inelastic materials. Further, the numerical treatment of these models will be addressed in the context of the finite element method. Finally, the according parameters will be identified by comparison with experiments. In particular, the following aspects will be addressed: • Elasticity at small and finite strains • Thermo-elasticity • Anisotropic elasticity for composites • Viscoelasticity – Creep an relaxation • Plasticity and hardening • Damage and crack initiation • Parameter identification

Media	e-Learning L²P, Power Point, voluntary e-Tests				
Literature	Lecture Notes, Audio Slides Students also receive a list of relevant literature				
Lectures / Examinations					
Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Mechanics of Engineering Materials		5	0	0	90
Lecture: Mechanics of Engineering Materials		0	2	45	0
Exercise: Mechanics of Engineering Materials		0	1	60	0
Teaching Unit / Examinations: Examination Mechanics of Engineering Materials					
Title	Examination Mechanics of Engineering Materials				
Sub-title	Exa MEM				
Semester	2				
Connection to the curriculum	Elective Module				
Teaching Unit / Examinations: Lecture Mechanics of Engineering Materials					
Title	Lecture Mechanics of Engineering Materials				
Sub-title	L MEM				
Semester	2				
Connection to the curriculum	Elective Module				
Teaching Unit / Examinations: Exercise Mechanics of Engineering Materials					
Title	Exercise Mechanics of Engineering Materials				
Sub-title	E MEM				

Semester	2
Connection to the curriculum	Elective Module

Module: Selected Chapters of Plant Engineering and Construction

Module	Selected Chapters of Plant Engineering and Construction
Module level	Master
Subtitle	SCPEC
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	apl. Prof. Dr.-Ing. Benno Hoffmeister
Lecturer	apl. Prof. Dr.-Ing. Benno Hoffmeister, Prof. Dr.-Ing. Christoph Butenweg
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Examination, Lecture, Project <u>Grading:</u> • seminar paper, grading: graded, weighting: 60% • presentation of research project and oral examination, grading: graded, weighting: 40%
Workload	Total 150h, Lecture hours 45h, Self-study 105h
Lecture hours	45h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	Presence in the project for participation in the final module examination.
Learning objectives	**Selected Chapters of Plant Engineering and Construction** After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • are familiarized with various topics that are relevant in the research domain as well as in different fields of application; • understand the basic principles of academic research and know how to approach a scientific problem;

	• know how to address questions, discuss and present scientific topics in front of a broad audience. <u>Abilities / Skills</u> Students • present themselves and their work within an international group using English language; • use media to support the oral presentation; • conduct small research projects autonomously. <u>Competencies</u> Students • overcome inhibition to discuss technical topics in plenum and utilize their new skills to expand their professional network. Within the course, they connect with guest lecturers from the industry as well as with academic lecturers to elaborate career opportunities
Content	**Selected Chapters of Plant Engineering and Construction** Selected chapters related to planning, construction, operation and management of industrial facilities. Guest lecturers from research and industry will be invited to share their knowledge and experience by lecturer-centred presentations and subsequent plenary discussions. Students will delve into one of the topics that are addressed in the course and prepare a seminar paper related to the chosen field. At the end of the semester, each student will present his work within a short presentation in front of the class and invited guests. In addition, a teaching unit will be offered to communicate basic information on how to prepare a scientific paper and how to properly present the content to a broad audience. During the semester, all academic tutors supervising student research projects will offer consultation hours to clarify formal aspects and discuss the progress of the project work.
Media	e-Learning L^{2}P, Power Point
Literature	Students receive a list of relevant literature, e.g.: • Lecture notes • Further reading for each topic discussed during the semester

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**	

			Lecture h. (SWS)	Self-Study (h)	Duration of Exam (min)
Examination: Selected Chapters of Plant Engineering and Construction		5	0	0	Seminar Paper: 10 – 100 pages Presentation and oral examination: 15-45 min.
Lecture: Selected Chapters of Plant Engineering and Construction		0	2	30	0
Project: Selected Chapters of Plant Engineering and Construction		0	1	75	0

Teaching Unit / Examinations: Examination Selected Chapters of Plant Engineering and Construction	
Title	Examination Selected Chapters of Plant Engineering and Construction
Sub-title	Exa SCPEC
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Lecture Selected Chapters of Plant Engineering and Construction	
Title	Lecture Selected Chapters of Plant Engineering and Construction
Sub-title	L SCPEC
Semester	2
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Project Selected Chapters of Plant Engineering and Construction	
Title	Project Selected Chapters of Plant Engineering and Construction
Sub-title	P SCPEC

Semester	2
Connection to the curriculum	Compulsory Module

Compulsory Course – Management

Second Term (Summer Semester)

RWTH Aachen (Faculty 8 – School of Business and Economics)

Module: Risk Management and Decision under Uncertainties

Module	Risk Management and Decision under Uncertainties
Module level	Master
Subtitle	RMDU
Lecture	See list of lectures and examinations of the module
Semester	2
Person in charge	Univ.-Prof. Dr. sc. pol. Thomas S. Lontzek
Lecturer	Univ.-Prof. Dr. sc. pol. Thomas S. Lontzek
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Risk Management and Decision under Uncertainties** *Overall goal: Students gain a comprehensive understanding of the concept of risk and decision making. They gain knowledge about concepts of strategic thinking and rational behaviour in presents of uncertainties. They familiarize with a wide range of risk management options.* After successfully completing this course, the students will have acquired the following learning outcomes:

	Knowledge / Understanding: Students • are familiar with theory and applications of descriptive and inferential statistics; • understand the challenges, opportunities and consequences of decision making under uncertainty. Abilities / Skills Students • recognize, categorize and prioritize risks; • adapt decision strategies to changing risk environments; • utilize qualitative and quantitative methods of decision making and risk management. Competencies Students • recognize, analyse and manage risks more efficiently, leveraging the quality of their personal and professional decisions.
Content	**Risk Management and Decision under Uncertainties** • Descriptive Statistics • Econometrics • Risk Assessment and Quantification • Risk Preferences, Strategies and Game Theory • Strategic and Dynamic Decision Making • Software for Risk Management • Research Methods • Robust Decision Making • Wide Range of Applications of Risk Management • Comprehensive case studies • Enterprise Risk Management • Strategic Management and Leadership • Systems and Operations Management
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations					
Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Risk Management and Decision under Uncertainties		5	0	0	see examination options
Lecture: Risk Management and Decision under Uncertainties		0	2	45	0
Exercise: Risk Management and Decision under Uncertainties		0	2	45	0

Teaching Unit / Examinations: Examination Risk Management and Decision under Uncertainties	
Title	Examination Risk Management and Decision under Uncertainties
Sub-title	Exa RMDU
Semester	2
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Risk Management and Decision under Uncertainties	
Title	Lecture Risk Management and Decision under Uncertainties
Sub-title	L RMDU
Semester	2
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Exercise Risk Management and Decision under Uncertainties	
Title	Exercise Risk Management and Decision under Uncertainties
Sub-title	E RMDU
Semester	2

Connection to the curriculum	Compulsory Module

Compulsory Courses – Engineering

Third Term (Winter Semester)

Ss. Cyril and Methodius University of Skopje

Module: Earthquake Engineering and Seismic Risk Assessment

Module	Earthquake Engineering and Seismic Risk Assessment
Module level	Master
Subtitle	EESRA
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Prof. Dr.-Ing. Elena Dumova-Jovanoska
Lecturer	Prof. Dr.-Ing. Elena Dumova-Jovanoska
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 40h, Self-study 110h
Lecture hours	40hours / 3 weeks
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Earthquake Engineering and Seismic Risk Assessment** *Overall goal:* • *Fundamentals of earthquake engineering with emphasis on design of seismic resistant structures.* • *Basic definition of seismic hazard, seismic vulnerability and seismic risk as well as the methods for assessments of seismic vulnerability and risk of buildings and case studies of industrial buildings.*

	After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • understand how to define seismic load; • know different types of seismic analysis; • know the basic principles of seismic design; • understand the relation of seismic hazard-vulnerability-risk; • know analytical methods for seismic vulnerability assessment. <u>Abilities / Skills</u> Students • make use of linear and nonlinear seismic analysis of structures; • apply analytical methodologies for definition of seismic vulnerability. <u>Competencies</u> Students • calculate the seismic response of structures; • define seismic vulnerability functions.
Content	**Earthquake Engineering and Seismic Risk Assessment** <u>Earthquake Engineering</u> • Earthquakes; nature, intensity, measurements • Earthquake response of linear single-degree-of-freedom systems • Earthquake response of inelastic single-degree-of-freedom systems • Earthquake response of linear multi-degree-of-freedom systems • Earthquake response, design and evaluation of multistory buildings <u>Seismic Risk Assessment</u> • Assessing and managing earthquake risk. An introduction • Overview on earthquake hazard assessment • Observation, characterization and prediction of strong ground motion • Vulnerability assessment of buildings • Vulnerability and risk assessment of lifelines • Damage scenarios and damage evaluation • Industrial facilities

Media	Power Point
Literature	Lecture Notes 1. K. Chopra: “Dynamics of Structures, Theory and Application to Earthquake Engineering”, Prentice Hall, 2012. 2. S. Oliveira, A. Roca, X. Goula (Editors), “Assessing and Managing Earthquake Risk: Geo-Scientific and Engineering Knowledge for Earthquake Risk Mitigation -Developments, Tools, Techniques”, Springer, 2006

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Earthquake Engineering and Seismic Risk Assessment		5	0	0	90
Lecture: Earthquake Engineering and Seismic Risk Assessment		0	40h/3weeks	60	0
Exercise: Earthquake Engineering and Seismic Risk Assessment		0		50	0

Teaching Unit / Examinations: Examination Earthquake Engineering and Seismic Risk Assessment

Title	Examination Earthquake Engineering and Seismic Risk Assessment
Sub-title	Exa EESRA
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Earthquake Engineering and Seismic Risk Assessment

Title	Lecture Earthquake Engineering and Seismic Risk Assessment
Sub-title	L EESRA
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Earthquake Engineering and Seismic Risk Assessment	
Title	Exercise Earthquake Engineering and Seismic Risk Assessment
Sub-title	E EESRA
Semester	3
Connection to the curriculum	Compulsory Module

Module: Engineering Ethics and Responsible Decision Making

Module	Engineering Ethics and Responsible Decision Making
Module level	Master
Subtitle	EERDM
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Associate Prof. Dr. Angelina Taneva-Veshoska
Lecturer	Associate Prof. Dr. Angelina Taneva-Veshoska
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture hours 40h, Self-study 110h
Lecture hours	40 hours / 3 weeks
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Engineering Ethics and Responsible Decision Making** *Overall goal: This course will prepare students with fundamental knowledge to successfully handle ethical/moral situations that might be encountered in* engineering *profession.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • know why it is important to study engineering ethics; • understand the distinction between professional and personal ethics;

	• understand the similarities between ethical problem solving and engineering design; • understand what codes of ethics are; • know how engineers can cooperate with each other, and with clients and government agencies to be sure that ethically correct choice is made. <u>Abilities / Skills</u> Students • describe the problem of many hands and explain how it applies to engineering. • examine some codes of ethics of professional engineering societies; • apply ethical theories to engineering situations; • apply ethical problem-solving methods to hypothetical and real cases; • apply the ethical cycle to engineering ethical cases and practice moral-decision making; • apply analytical skills through investigation and evaluation of ethical problems in engineering settings using accepted tests for moral problem solving; • describe how engineering designs may affect the distribution of responsibility; <u>Competencies</u> Students • identify ethical issues at the different stages at the design process; • discuss the responsibilities and rights that engineers have; • analyse and evaluate the complex consequences and motives that typically attend moral issues in engineering practice; • determine what whistle-blowing is and when it is appropriate to blow the whistle; • develop team skills through working in teams on assignments and in-class assignments; • improve skills in both written and oral communication with regard to ethical and professional issues in engineering.
Content	**Engineering Ethics and Responsible Decision Making** **1. Introduction** • The importance of ethics in engineering • Personal vs. professional ethics • The origins of ethical thought • A statement of ethical principles • Ethics and the law

	• Ethical problem solving and engineering design **2. Professionalism and Code of ethics** • Understanding ethical problems • Ethical theories • The role of Codes of ethics • Code of ethics of professional engineering societies • Violating the codes • Sustainability, ethics and technology **3. Ethical problem-solving techniques** • Analysis and issues in ethical problems • Different methods: line drawing, flow charting, conflict problems • The ethical cycle (moral problem statement, problem analysis, options for actions, ethical evaluation, reflection) • Application of problem-solving methods **4. Rights and responsibilities of engineers** • Professional responsibilities • Professional rights • Engineering standards • Passive and active responsibility • The distribution of responsibility in engineering • Problem of many hands in engineering • Factors affecting moral responsibility and degrees of responsibility • Whistle-blowing • Moral leadership • Creating **an ethical organization** **5. Moral choices and ethical dilemmas** • Responsible decision making – doing the right thing • Preventing corruption • Gift giving and bribery • Conflict of interest • Trade secrets • Fair treatment • Data integrity • Public safety and welfare • Dealing with differing ethical systems • Organizational **and individual case studies**
Media	• group work (presentation, workshop, discussions, questions & answers, role-play, case-work); • e-learning (article, video, ppt, forum, self-assessment); • individual work (reflection – writing assessments, paper assignments).
Literature	1. Van de Poel, I. and Royakkers, L. (2011). Ethics, Technology, and Engineering: An Introduction. Willey-Blackwell, United Kingdom. 2. Seebauer, E. and Barry, R. (2001). Fundamental of Ethics: for scientists and engineers. Oxford University Press, United Kingdom.

	3. Baura, G. (2006). Engineering Ethics: An industrial perspective. Elsevier Academic Press, USA. 4. Martin, M. and Schinzinger, R. (2000). Introduction to Engineering Ethics. McGraw-Hill, USA 5. Bowen, R. (2014). Engineering Ethics: Challenges and Opportunities. Springer, United Kingdom.

Lectures / Examinations

Title	Code	ECTS	Workload (SWS / h)		Duration of Exam (min)
			Lecture h. (SWS)	Self-Study (h)	
Examination: Engineering Ethics and Responsible Decision Making		5	0	0	90
Lecture: Engineering Ethics and Responsible Decision Making		0	40h/3weeks	60	0
Exercise: Engineering Ethics and Responsible Decision Making		0		50	0

Teaching Unit / Examinations: Examination Engineering Ethics and Responsible Decision Making

Title	Engineering Ethics and Responsible Decision Making
Sub-title	Exa EERDM
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Engineering Ethics and Responsible Decision Making

Title	Lecture Engineering Ethics and Responsible Decision Making
Sub-title	L EERDM
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Exercise Engineering Ethics and Responsible Decision Making

Title	Exercise Engineering Ethics and Responsible Decision Making
Sub-title	E EERDM

Semester	3
Connection to the curriculum	Compulsory Module

Elective Courses – Management and Engineering

Third Term (Winter Semester)

Maastricht School of Management (MSM) and RWTH Aachen (Faculty 3 – Civil Engineering)

Module: Computational Methods for Advanced Materials and Structures

Module	Computational Methods for Advanced Materials and Structures
Module level	Master
Subtitle	CMAMS
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Dr.-Ing. Jaan-Willem Simon
Lecturer	Dr.-Ing. Jaan-Willem Simon
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Written examination, Lecture, Exercise
Workload	Total 150h, Lecture Hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Computational Methods for Advanced Materials and Structures** After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • know the phenomena which have to be dealt with in advanced engineering problems;

	• know the different material models which have been proposed to describe these phenomena including the materials' failure; • understand the basic concept of how to treat these models numerically by applying the finite element method to nonlinear problems. <u>Abilities / Skills</u> Students • analyse numerical results with respect to the quality of the adopted model; • predict the failure state of engineering materials; • predict the limit states of engineering structures; • transfer theoretical knowledge to actual engineering problems from the fields of mechanical, civil, and aeronautical engineering; • program user defined sub-routines within the commercial finite element solver Abaqus. <u>Competencies</u> Students • critically assess the applicability and correctness of computational methods being applied to recent engineering problems in design and analysis.
Content	**Computational Methods for Advanced Materials and Structures** The purpose of this course is to give an insight into the application of computational methods to advanced materials and structures. The major objective is the understanding of how engineering problems can be treated numerically by means of the finite element method accounting for geometrical and/or material nonlinearity. In particular, the following aspects will be addressed: • Overview of nonlinear material models for advanced engineering materials, such as metals, concrete, plastics, and composites: elasticity, visco-elasticity, elasto-plasticity, visco-plasticity • Failure of materials: fracture, progressive damage, low- and high-cycle fatigue • Limit states of structures and structural components: analysis of stability (buckling), response to dynamical loadings, shakedown analysis • Numerical treatment of the model mentioned above in the context of nonlinear finite element analysis

	• Numerical aspects: convergence behaviour, locking, robustness and efficiency • Implementation into user defined sub-routines in Abaqus
Media	e-Learning L^{2}P, Power Point, AudioSlides
Literature	Lecture Notes, AudioSlides Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Computational Methods for Advanced Materials and Structures		5	0	0	90
Lecture: Computational Methods for Advanced Materials and Structures		0	2	45	0
Exercise: Computational Methods for Advanced Materials and Structures		0	2	45	0

Teaching Unit / Examinations: Examination Computational Methods for Advanced Materials and Structures

Title	Examination Computational Methods for Advanced Materials and Structures
Sub-title	Exa CMAMS
Semester	3
Connection to the curriculum	Elective Module

Teaching Unit / Examinations: Lecture Computational Methods for Advanced Materials and Structures

Title	Lecture Computational Methods for Advanced Materials and Structures
Sub-title	L CMAMS

Semester	3
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Computational Methods for Advanced Materials and Structures	
Title	Exercise Computational Methods for Advanced Materials and Structures
Sub-title	E CMAMS
Semester	3
Connection to the curriculum	Elective Module

Module: Leadership and Organizational Behaviour

Module	Leadership and Organizational Behaviour
Module level	Master
Subtitle	LOB
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Prof. Jane Kushma, PhD
Lecturer	Prof. Jane Kushma, PhD
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Interactive lectures, case analysis sessions, computer hands-on, group project presentations and discussions.
Workload	Total 140 hours: 40 hours in class, 100 hours self study.
Lecture hours	40 hours / 3 weeks
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Leadership and Organizational Behaviour** After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • know the different styles, behaviours, competencies and roles of leadership; • understand the impact of the leader on an organizational culture and change; • understand the personal and individual differences; • know the relation between decision-making and problem solving.

	Abilities / Skills Students • apply the appropriate methods and tools to solve contemporary business and management challenges. Competencies Students • evaluate the nature, the impact of and the concepts of leadership styles and approaches and management tasks and roles in a globalizing, multicultural context; • evaluate and determine leader attributes and actions leading to business decisions regarding organizational teams and tasks that impact on both organizational performance and society; • analyse strengths and weaknesses of different approaches to leadership. To use this knowledge for the suggestion comparison and evaluation of ideas and solutions to situational problems.
Content	**Leadership and Organizational Behaviour** **Leadership Theories** • The importance of leadership – definitions and distinctions • The context for leadership • Classic theories of leadership • Contemporary theories of leadership • Assessing leadership **Organizational Theories** • Classic organizational theory • Human resource theory • Modern structural organizational theory • Power and politics organizational theory • Organizational culture • Case analyses **The Special Circumstances of Crisis** • Crises are inevitable a. "Normal Accidents" – Charles Perrow b. Signal detection – Ian Mitroff • Governing after crisis a. Crisis-induced accountability b. Crisis-induced learning and policy change • Crisis leadership challenges • Crisis decision making • Crisis leadership lessons **The Emergency Management Case**

	• The emergency management context • Applying leadership to the emergency management cycle • Emergency management principles and leadership • Ethical leadership • A call for collaborative leadership • Leadership development **Disaster Simulation**
Media	• group work (presentation, workshop, discussions, questions & answers, role-play, case-work); • e-learning (article, video, ppt, forum, self-assessment); • individual work (reflection – writing assessments, paper assignments).
Literature	Students receive a list of individual literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Leadership and Organizational Behaviour		5	0	0	180
Lecture: Leadership and Organizational Behaviour		0	40h/3weeks	50	0
Exercise: Leadership and Organizational Behaviour		0		50	0

Teaching Unit / Examinations: Examination Leadership and Organizational Behaviour

Title	Examination Leadership and Organizational Behaviour
Sub-title	Exa LOB
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Leadership and Organizational Behaviour

Title	Lecture Leadership and Organizational Behaviour

Sub-title	L LOB
Semester	3
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise Leadership and Organizational Behaviour	
Title	Exercise Leadership and Organizational Behaviour
Sub-title	E LOB
Semester	3
Connection to the curriculum	Compulsory Module

Compulsory Courses – Management

Third Term (Winter Semester)

Maastricht School of Management (MSM)

Module: Probabilistic Risk Analysis in Industrial Facilities

Module	Probabilistic Risk Analysis in Industrial Facilities
Module level	Master
Subtitle	PRAIF
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Prof. David Steffy, PhD
Lecturer	Prof. David Steffy, PhD
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Interactive lectures, case analysis sessions, computer hands-on, group project presentations and discussions.
Workload	Total 140 hours: 40 hours in class, 100 hours self study.
Lecture hours	40 hours / 3 weeks
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Probabilistic Risk Analysis in Industrial Facilities** *Overall goal: This course will cover concepts and methods to conduct quantitative risk assessment at industrial facilities. The course will address these concepts in a systems analysis approach by examining a facility's main operational components, and how each component could contribute to a facility's risk. The course will examine which components could be changed to mitigate the risk. The course will conclude with a discussion of case studies which illustrate successful and unsuccessful risk mitigation.*

	After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • understand the basic concepts of risk analysis; • understand more complicated approaches for risk analysis of industrial systems with multiple layers of risk; • understand the computational approach to quantitative analysis including an understanding of probabilistic occurrence and conditional occurrence.
Content	**Probabilistic Risk Analysis in Industrial Facilities** **Background of Risk Assessment of Facilities** • Elements of risk management. • Terms – hazard, risk, risk analysis, and risk assessment. • Systems approach to conduct qualitative and quantitative risk assessments. • Main steps to conduct risk assessment, which includes hazard identification, hazard analysis, probability of occurrence, and consequence of occurrence. • Hazard identification with respect to: raw material, plant operation, operational environment, operational activity, and how it relates to the system. • The concept of probabilistic risk assessment **Screening, Preliminary Analysis Techniques, and What-If Analysis** • Simple techniques to identify the hazard. • Screening by indices that detect the onset of risk generation. • Dow/Mond indices. • What-if analysis requirements for implementation, data gathering, interpretation, and results. • Advantages and disadvantages of indices, preliminary analysis, and what-if analysis. **Special Quantitative Methods of Risk Analysis**

	• Complicated methods used to identify the risks that require preplanning. • Hazard and operability (HAZOP) method is used to conduct risk assessment of a facility. This systematic approach applies a uniform, reproducible method that can be adapted to a wide variety of industrial settings. Analysis is conducted by following a matrix of process variables versus level and type of variation. The individual elements are decided on by a team of evaluators. • Failure mode and effects analysis (FMEA) and immediate consequence of the event. • Fault-tree analysis • Event-tree analysis • Bow-tie analysis **Quantitative Risk Assessment and Management Strategies** • Concepts and steps required in the collection, management, and the use of quantitative risk analysis. • Uncertainty and sensitivity analysis of risk information. • Terms – acceptable risk, risk contours, and risk communication. • Perceived risk and human reliability. **Case Studies** A variety of industries will be reviewed to illustrate risks caused by the industrial process and risk caused by an accident or a deviation away from the intended industrial system. 1. Industrial Ecology (Kalundborg, Denmark) is an example of how industry can reduce risk by cooperating with government, other industries, and the public. 2. Industry Type & Common Risk a. Monsanto (Anniston, Alabama, US) is a chemical process plant and is an example of how not to dispose of a highly toxic waste and sloppy handling of toxic chemicals during the industrial process. b. Anniston Army Depot (Alabama, US) is an example of how careless handling of highly toxic TCE is release to the environment and has now crossed the property boundary. c. Metal recycling results in toxic metal contamination of soil and eroded sediment. d. Colonial Pipeline & Storage Facility (Birmingham, Alabama, US) that has experienced release of petroleum into the soil and water resources.

	e. Veteran Administration Medical Centers in 23 facilities across 5 states exhibit common operational problems that increase their risk.
Media	• group work (presentation, workshop, discussions, questions & answers, role-play, case-work); • e-learning (article, video, ppt, forum, self-assessment) • individual work (reflection – writing assessments, paper assignments).
Literature	Students receive a list of individual literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Probabilistic Risk Analysis in Industrial Facilities		5	0	0	180
Lecture: Probabilistic Risk Analysis in Industrial Facilities		0	40h/3weeks	50	0
Exercise: Probabilistic Risk Analysis in Industrial Facilities		0		50	0

Teaching Unit / Examinations: Examination Probabilistic Risk Analysis in Industrial Facilities	
Title	Examination Probabilistic Risk Analysis in Industrial Facilities
Sub-title	Exa PRAIF
Semester	3
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Lecture Probabilistic Risk Analysis in Industrial Facilities	
Title	Lecture Probabilistic Risk Analysis in Industrial Facilities
Sub-title	L PRAIF
Semester	3
Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise Probabilistic Risk Analysis in Industrial Facilities	

Title	Exercise Probabilistic Risk Analysis in Industrial Facilities
Sub-title	E PRAIF
Semester	3
Connection to the curriculum	Compulsory Module

Module: Project Management in the Context of Disasters

Module	Project Management in the Context of Disasters
Module level	Master
Subtitle	PMCD
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Scott R. Manning, M.Sc.
Lecturer	Scott R. Manning, M.Sc.
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Interactive lectures, case analysis sessions, computer hands-on, group project presentations and discussions.
Workload	Total 140 hours: 40 hours in class, 100 hours self study.
Lecture hours	40 hours/ 3 weeks
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Project Management in the Context of Disasters** *Overall goal: This course is designed to provide students with an understanding of the fundamental concepts, theories, principles, and practices of project management in the context of risk and disaster management.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students

	• understand how key management functions interact in the project environment. <u>Abilities / Skills</u> Students • apply project management methods, processes and tools to execute complex projects; • examine the role of project management in risk and disaster management; • apply project management methods, processes and tools to execute complex projects.
Content	**Project Management in the Context of Disasters** **Project Management in the Context of Disasters** • Defining projects and project management • Projects in the context of risk and disaster management • Knowledge, skill sets, and roles of the risk/disaster project manager • Linkages between projects and organizational strategy • Functions of program and portfolio management • Project management process groups • Project management knowledge areas **Identifying and Initiating Projects for Risk and Disaster Management** • Clarifying organizational mandates, mission, and values • Analyzing hazards and vulnerabilities and determining associated risks • Analyzing internal capabilities and the broader operational environment • Identifying and analyzing the needs of community stakeholders • Identifying strategic issues, strategies, and potential projects • Selecting projects and developing the project charter **Planning for Risk and Disaster Management Projects** • Defining and developing the project management plan • Defining the project scope and creating the work breakdown structure • Sequencing activities/resources and developing the project schedule • Estimating/controlling project costs and formulating the project budget • Organizing and staffing for project management • Identifying, mitigating, and managing project risk • Project evaluation and quality assurance **Executing and Monitoring Projects for Risk and Disaster Management** • Project integration and the role of the project manager • Ethics and professional conduct for project managers • Acquiring, developing, and managing the project team

	• Monitoring and controlling project activities and resources • Verifying and controlling the project schedule • Verifying and controlling project-related costs • Monitoring and controlling for project quality • Project communication and stakeholder management • Finalizing and closing the project **Simulation**
Media	• group work (presentation, workshop, discussions, questions & answers, role-play, case-work); • e-learning (article, video, ppt, forum, self-assessment) • individual work (reflection – writing assessments, paper assignments).
Literature	Students receive a list of individual literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Project Management in the Context of Disasters		5	0	0	180
Lecture: Project Management in the Context of Disasters		0	40 hours / 3 weeks	50	0
Exercise: Project Management in the Context of Disasters		0		50	0

Teaching Unit / Examinations: Examination Project Management in the Context of Disasters

Title	Examination Project Management in the Context of Disasters
Sub-title	Exa PMCD
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Project Management in the Context of Disasters

Title	Lecture Project Management in the Context of Disasters
Sub-title	L PMCD
Semester	3

Connection to the curriculum	Compulsory Module
Teaching Unit / Examinations: Exercise Project Management in the Context of Disasters	
Title	Exercise Project Management in the Context of Disasters
Sub-title	E PMCD
Semester	3
Connection to the curriculum	Compulsory Module

Module: Foundations in Emergency Management

Module	Foundations in Emergency Management
Module level	Master
Subtitle	FEM
Lecture	See list of lectures and examinations of the module
Semester	3
Person in charge	Scott R. Manning, M.Sc.
Lecturer	Scott R. Manning, M.Sc.
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Interactive lectures, case analysis sessions, computer hands-on, group project presentations and discussions.
Workload	Total 140 hours: 40 hours in class, 100 hours self study.
Lecture hours	40 hours / 3 weeks
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Foundations in Emergency Management** *Overall goal: This course is designed to provide students with the fundamental concepts, theories, principles, and practices in emergency management.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • have a comprehensive understanding of guiding principles of emergency management as considered in the scholarly literature and consider how they are reflected in practice;

	• understand the political, social, and economic contexts for disaster. <u>Abilities / Skills</u> Students • examine current professional and managerial challenges from an inter-organizational and inter-governmental perspective; • explore solutions to common problems experienced by emergency managers. <u>Competencies</u> Students • assess the future of emergency management, policy directions, and needed research.
Content	**Foundations in Emergency Management** **The Discipline and Profession of Emergency Management** • The evolution of emergency management • Definitions - crises, emergencies, disasters, catastrophes, complex humanitarian events, and distinctions among the types • The knowledge base of emergency management • Social science perspectives and disaster myths • Professional practice and ethical considerations • Establishing the emergency management program • Assessment and evaluation • Evidence-based practice **The Nature of Risk, Vulnerability, and Resilience** • Risk as a social construct • Assessing risk – hazard identification, hazard analysis, impact analysis • Assessing vulnerability • The shift towards resilience thinking **The Disaster Cycle** • The cycle explained • Developing strategy • The role of planning • Disaster models **Contemporary Issues and Managerial Challenges** • Incident management systems • Communications and interoperability • Resource management and logistics • Information management • Leadership and decision-making

	• Crisis communications and crisis management • Long-term recovery • Catastrophic disasters • Climate change **Simulation**
Media	• group work (presentation, workshop, discussions, questions & answers, role-play, case-work); • e-learning (article, video, ppt, forum, self-assessment) • individual work (reflection – writing assessments, paper assignments).
Literature	Students receive a list of individual literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Foundations in Emergency Management		5	0	0	180
Lecture: Foundations in Emergency Management		0	40h/3weeks	50	0
Exercise: Foundations in Emergency Management		0		50	0

Teaching Unit / Examinations: Examination Foundations in Emergency Management

Title	Examination Foundations in Emergency Management
Sub-title	Exa FEM
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Lecture Foundations in Emergency Management

Title	Lecture Foundations in Emergency Management
Sub-title	L FEM
Semester	3
Connection to the curriculum	Compulsory Module

Teaching Unit / Examinations: Exercise Foundations in Emergency Management	
Title	Exercise Foundations in Emergency Management
Sub-title	E FEM
Semester	3
Connection to the curriculum	Compulsory Module

Elective Courses – Engineering

Fourth Term (Summer Semester)

RWTH Aachen (Faculty 3 – Civil Engineering)

Module: Introduction to Research

Module	Introduction to Research
Module level	Master
Subtitle	IR
Lecture	See list of lectures and examinations of the module
Semester	4
Person in charge	Dr.-Ing. Jaan-Willem Simon
Lecturer	Dr.-Ing. Jaan-Willem Simon
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Written examination, Lecture, Exercise (Homework)
Workload	Total 150h, Lecture hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	Written or oral exam (will be announced at the beginning of the semester); Exam requirements: the homework has to be passed.
Learning objectives	**Introduction to Research** *Overall goal: Getting an insight into research and scientific methods as well as preparing students for writing their Master's thesis.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students • have a good understanding of the basics in scientific research and the corresponding methods;

	• have knowledge about how to present one's work in written and/or oral form; • know methods and skills that are helpful for efficient, effective, and systematic research; • know about good scientific practices (e.g. how to cite properly); <u>Abilities / Skills</u> Students • perform literature reviews independently; • write papers or a thesis according to the rules of good scientific practice; • express scientific content in persuasive presentations. <u>Competencies</u> Students • write and present scientific results in a professional manner; • have an awareness of ethical aspects in research (e.g. plagiarism).
Content	**Introduction to Research** This course provides students with guidelines for good scientific research. Concepts and methods are presented which are intended to help the students write their Bachelor's or Master's thesis efficiently and systematically. Topics are: • the concept of „research" • planning and writing Bachelor's/Master's/Doctoral theses or scientific articles Assembly procedure • presentation of research work in various forums • the use of tables and figures • proper citation, especially of electronic sources • ethical issues in research
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations				
Title	**Code**	**ECTS**	**Workload (SWS / h)**	

			Lecture h. (SWS)	Self-Study (h)	Duration of Exam (min)
Examination: Introduction to Research		5	0	0	30/90
Lecture: Introduction to Research		0	2	45	0
Exercise (Homework): Introduction to Research		0	2	45	0

Teaching Unit / Examinations: Examination Introduction to Research	
Title	Examination Introduction to Research
Sub-title	Exa IR
Semester	4
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Lecture Introduction to Research	
Title	Lecture Introduction to Research
Sub-title	L IR
Semester	4
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Exercise (Homework) Introduction to Research	
Title	Exercise (Homework) Introduction to Research
Sub-title	E IR
Semester	4
Connection to the curriculum	Elective Module

Module: Engineering, Culture and Society

Module	Engineering, Culture and Society
Module level	Master
Subtitle	ECS
Lecture	See list of lectures and examinations of the module
Semester	4
Person in charge	Univ.-Prof. Dr. phil. Carmen Leicht-Scholten
Lecturer	Univ.-Prof. Dr. phil. Carmen Leicht-Scholten
Language	English
Assignment to the curriculum	Elective Module
Teaching form	Lecture, Exercise, Presentation, Written homework
Workload	Total 150h, Lecture Hours 60h, Self-study 90h
Lecture hours	60h
ECTS-Credit Points (CP)	5
Requirements according to examination regulation	-none-
Learning objectives	**Engineering, Culture and Society** *Overall goal: The course aims on the reflection and analyses of engineering processes, practices, and cultures. It wants to enable students to expand their perspectives and to apply new approaches of gender and diversity within their future work.* After successfully completing this course, the students will have acquired the following learning outcomes: <u>Knowledge / Understanding</u> Students: • understand gender and diversity concepts; • explain mechanisms of gender and diversity theory;

	• are familiar with a variety of application scopes for the integration of gender and diversity in management and engineering. <u>Abilities / Skills</u> Students: • critically reflect their own attitudes, disciplinary and culturally shaped ways of thinking in management and engineering; • apply theoretical knowledge and can identify gender and diversity issues within engineering practice; • verbalize their thoughts according to scientific standards. <u>Competencies</u> Students: • analyse and rethink disciplinary perspectives of management and engineering; • critically reflect and scrutinize concrete given tasks and challenges of engineering practice; • develop own ideas and concepts to integrate gender and diversity perspectives into application cases and their future work on their own; • develop own integrated problem solution strategies to integrate gender and diversity perspectives into application cases and their future work on their own; • concretize, conceptualize and present their thoughts according to scientific standards; • work in interdisciplinary and diverse teams.
Content	**Engineering, Culture and Society** This course will consider how culture shapes and impacts engineering, with a particular focus on the cultural aspects of gender that affect who becomes an engineer, what problems get solved, and the quality of solutions, technology, and products. We will examine engineering cultures and gender through the lens of theories, concepts and approaches of the social sciences, which extend the engineering education and practice with interdisciplinary and innovative perspectives. We will also take into account the role and impact engineering and technology have for society and why it makes sense to reflect different approaches. Technical processes are determined by the people carrying them out, their disciplinary backgrounds, their views, and the methods they use. How do these backgrounds affect ways of thinking and practice? How do they

	influence outcomes, and the development in innovation and research? Does gender matter? What does Diversity mean? How can the integration of gender and diversity perspectives help to find sustainable solutions? Furthermore within the course we want to reflect and examine in which different ways gender and diversity issues affect management and engineering in different fields. The course gives insights about gender and diversity basic theory, and it illustrates how these appear in engineering practice. We will learn how the consideration of gender and diversity essentially contribute to ecological and socially sustainable solutions, and technical innovation. The course contains of two parts, one more theoretical lecture part in which theories and concepts are imparted and discussed. The second part is a strongly application-oriented unit, which offers the students the possibility to actively be engaged. In concrete practical cases they have to apply theoretical knowledge and develop solutions on themselves. The whole course aims on a fundamental reflection of assumptions, ways of thinking, and disciplinary perspectives of technology and engineering and its relations to society.
Media	e-Learning L^{2}P, Power Point
Literature	Lecture Notes Students also receive a list of relevant literature

Lectures / Examinations

Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-Study (h)**	
Examination: Engineering, Culture and Society		5	0	0	Written homework (5-10 Pages) Presentation (15-60 min.)
Lecture: Engineering, Culture and Society		0	2	45	0
Lecture: Engineering, Culture and Society		0	2	45	0

Teaching Unit / Examinations: Examination Engineering, Culture & Society

Title	Examination Engineering, Culture and Society
Sub-title	Exa ECS
Semester	4
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Lecture Engineering, Culture and Society	
Title	Lecture Engineering, Culture and Society
Sub-title	L ECS
Semester	4
Connection to the curriculum	Elective Module
Teaching Unit / Examinations: Exercise Engineering, Culture and Society	
Title	Exercise Engineering, Culture and Society
Sub-title	E ECS
Semester	4
Connection to the curriculum	Elective Module

Compulsory Course – Master Thesis
Fourth Term (Summer Semester)

Module: Master Thesis

Module	Master Thesis
Module level	Master
Subtitle	MaTh
Lecture	See list of lectures and examinations of the module
Semester	4
Person in charge	RWTH Aachen / MSM
Lecturer	RWTH Aachen / MSM
Language	English
Assignment to the curriculum	Compulsory Module
Teaching form	Supervision and assistance by the relevant professor
Workload	6 Months
Lecture hours	-
ECTS-Credit Points (CP)	25
Requirements according to examination regulation	The topic of the Master thesis cannot be assigned until 80 CPs have been achieved. Reasonable exceptions are governed by the Board of Examiners upon request by the candidate.
Learning objectives	The students learn the independent approach and processing of academic themes, their documentation and written interpretation within a set deadline. They acquire systematic academic research skills.
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.
Media	-
Literature	According to the relevant research questions of the Master Thesis

Lectures / Examinations					
Title	**Code**	**ECTS**	**Workload (SWS / h)**		**Duration of Exam (min)**
			Lecture h. (SWS)	**Self-study (h)**	
Master Thesis and Master Thesis Defense Colloquium		25	0	0	Master Thesis (~80 pages) Master Thesis Defense Colloquium (15-60 min.)
Teaching Unit / Examinations: Examination Master Thesis					
Title	Master Thesis				
Sub-title	Exa MaTh				
Semester	4				