Appendix B: Module catalogue

for the study programme Optimisation and Simulation M.Sc.

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Bionic Methods of Optimisation					BMO
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2015	180 h	6	1st or 2nd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	2	weekly hours	30	h	60	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

The students know the concept of bionics as well as types and procedures of bionic optimisation algorithms. The students are able to assess for which problems bionic algorithms, especially genetic algorithms, are suitable, as well as evaluate the quality of the optimisation results. They can structure and model given problems in such a way that bionic algorithms become applicable. They are able to use neural networks for modelling and increasing efficiency.

3 Contents:

Classification of optimisation algorithms (heuristic, combinatorial, analytical, bionic). Types of heuristic procedures: Random walk, hill climbing, simulated annealing, genetic algorithms, other stochastic methods.

On genetic algorithms: Biological model, mathematical operators (selection, mutation, etc.), theoretical background (schema theorem, building block hypothesis, speed of convergence). Evolutionary strategies, differential evolution, particle swarming, ant algorithms, bee swarming algorithms. Case studies, classic test functions (Rosenbrock saddle, Travelling Salesperson, etc.).

Implementation of a programming project.

Basics of artificial neural networks, the most important models, areas of application, especially in optimisation tasks.

4 Forms of teaching:

Seminar lessons with project work

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Project work

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

BioMechatronics M.Sc. and Optimisation and Simulation M.Sc.

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr. phil. Bernhard Bachmann

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11	Other information: Literature will be announced at the beginning of the course. - Gerdes et. al, Evolutionäre Algorithmen - Script Neural Networks
12	Language: German

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Discrete Optimisation					DOPT
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2035	180 h	6	1st or 2nd sem.	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	2	weekly hours	30	h	60	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

The students are familiar with different problem characteristics and the corresponding solution methods of integer and combinatorial optimisation problems and are able to solve relevant real-world problems with the help of suitable models and methods of discrete optimisation.

3 Contents:

- Integer linear optimisation problems
- Branch and bound method
- Cutting method for solving discrete optimisation problems
- Column generation and branch & price
- Knapsack problems
- Assignment and transport problems
- Travelling Salesperson problems
- Scheduling problems (machine allocation, flow production)
- Cutting-stock & bin-packing problems
- Facility & hub location problems

4 Forms of teaching:

Seminar lessons with accompanying exercise

5 Participation requirements:

Formal:	None
Content:	Basic knowledge of linear optimisation

6 Forms of assessment:

Term paper, written examination, combination examination, project work or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Optimisation and Simulation M.Sc.

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr. Jonas Ide

11 Other information:

Literature will be announced at the beginning of the course.
The course material is summarised in a script that accompanies the lecture.

12 Language:

German

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Discrete Simulation and Reinforcement Learning								DSRL
Identification number:	Workload:	Credits:	Study semester:		Frequency of the offer:			Duration:
2061	180	6	1st or 2nd sem.		Annual (Summer)			1 sem.

1	Course:	Planned group sizes:	Scope:		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	0	weekly hours	0	h	0	h
	Sem. lessons	30 students	2	weekly hours	30	h	60	h
	Exercise	20 students	2	weekly hours	30	h	60	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students		weekly hours		h		h

2 Learning outcomes/competences:

Students are familiar with the basic principles of discrete simulation and are able to build time-discrete, agent-based simulation models using simulation software. They know basic and advanced methods of reinforcement learning and can apply them using a higher programming language. They are able to use the methods of discrete simulation they have learned to model and analyse practical problems. In addition, they are able to combine simulation and reinforcement learning to train an AI to make optimal decisions in a practical context.

3 Contents:

The course consists of three parts:

- Introduction to discrete simulation: time-discrete simulation, event-discrete simulation, agent-based simulation, discrete automata, queues, simulation tools
- Introduction to reinforcement learning: fundamentals of reinforcement learning, fundamentals of supervised learning with deep neural networks, Bellman equation, deep-Q learning

Modeling concrete problems: both weekly in the practical part of the course as well as in the combination examination in the context of a group project.

4 Forms of teaching:

Seminar lessons with project work

5 Participation requirements:

Formal:	
Content:	

6 Form of assessment:

Combination exam

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes):

Research Master Data Science and Optimisation and Simulation M.Sc.

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr. Jonas Ide

11 Other information:

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12	Language:
	English

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Colloquium					MKO
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2033	180 h	6	3rd or 4th semester	each semester	

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	0	weekly hours	0	h	180	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: The colloquium complements the master thesis and is to be assessed independently. It serves to determine whether the candidate is capable of orally presenting and independently justifying the scientific topic of the master thesis, its subject-related foundations, its interdisciplinary connections and its non-subject-related references, as well as assessing its significance for practice.
3	Contents: - Content of the thesis according to the topic - Disputation on the procedure in the preparation of the thesis and the questions that arose in the context of the thesis
4	Forms of teaching: Oral examination for the master thesis
5	Participation requirements: Formal: None Content: Treatment of the master thesis
6	Forms of assessment: Oral examination
7	Prerequisite for the award of credit points:
8	Application of the module (in the following study programmes) Electrical Engineering M.Eng., Research Master Data Science, Mechanical Engineering M.Sc. and Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: N.N.
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Management Skills					MMK
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2006	180 h	6	1st or 2nd semester	Annual Summer	1 sem.

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	2	weekly hours	30	h	60	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

Students know and understand different management methods and can apply them to specific cases. They understand the connection between corporate goals, leadership culture and social mission. They have learned to analyse entrepreneurial measures from different perspectives. They can evaluate their own behaviour/perception more realistically. They can use methods to motivate employees and themselves, to work successfully in a team and to react sensibly in case of conflict or crisis. They can apply methods to deal sensibly with high task loads.

3 Contents:

Strategic corporate planning, motivational theories, leadership methods, values in management, social, professional and methodological competence, general legal issues, occupational safety, environmental protection, energy and resource efficiency, sustainable economic activities, code of German references, intercultural management, global development and production strategies, project management, self-management, target tracking and controlling, balanced score card, technology excellence level, change management, conflict management, stress and time management, communication in the event of a crisis.

4 Forms of teaching:

Lectures, case studies, exercises

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination, combination examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Electrical Engineering M.Eng., Mechanical Engineering M.Sc. and Optimisation and Simulation M.Sc.

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr.-Ing. Bruno Hüsgen

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11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Master Thesis					M.A.
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2034	720 h	24	3rd or 4th semester	each semester	20 weeks

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	0	weekly hours	0	h	720	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences:	
	With the master thesis, each candidate demonstrates that he/she is able to complete a practice-oriented task from his/her subject area within a specified period of time, both in its subject-specific details and in the interdisciplinary contexts, working independently and according to scientific methods.	
3	Contents:	
	The master thesis is an independent scientific work from the subject area of the respective study programme with a description and explanation of its solution. It can also be determined by an empirical investigation or by conceptual or design tasks or by an evaluation of existing sources. A combination of these forms is possible.	
4	Forms of teaching:	
	Written composition with faculty tutoring	
5	Participation requirements:	
	Formal:	None
	Content:	Coordinated topic from the student's special subject area
6	Forms of assessment:	
7	Prerequisite for the award of credit points:	
8	Application of the module (in the following study programmes)	
	Electrical Engineering M.Eng., Research Master Data Science, Mechanical Engineering M.Sc. and Optimisation and Simulation M.Sc.	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module coordinator:	
	N.N.	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

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Mechatronic Systems					MS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2014	180 h	6	1st or 2nd semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	2	weekly hours	30	h	60	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

Students can apply standardised methods to describe the kinematics and dynamics of technical systems.
Students can describe mechatronic design processes and know their special characteristics.
Students can create and analyse linear, time-invariant models for mechatronic systems. They can apply selected methods to synthesise and select components.

3 Contents:

Basic kinematic principles:
Kinematics of the point, the rigid and the solid body, the systems of rigid bodies in spatial motion

Synthetic mechanics:
Axioms of Newton and Euler (impulse theorem, twist theorem)

Kinematics in the relative system

Analytical mechanics, differential and integral principles:
Principle of virtual work, d'Alembert's principle, Lagrange's liberation principle

Hamilton's principle, Lagrange's equations

Structure and functioning of mechatronic systems and their special characteristics

Design methodology for mechatronic systems

Modelling, analysis and synthesis of the dynamic system behaviour of mechatronic systems

4 Forms of teaching:

Lecture, seminar lessons

5 Participation requirements:

Formal:	None
Content:	None

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6	Forms of assessment: Written examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) BioMechatronics M.Sc. and Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr.-Ing. Peter Reinold
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Multi-Body Simulation					MKS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2011	180 h	6	1st or 2nd semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	1	weekly hours	15	h	30	h
	Practical or seminar	15 students	1	weekly hours	15	h	30	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

Students will be able to apply standardised methods for describing the kinematics and dynamics of mechanical and mechatronic systems, analyse the kinematics and dynamics of mechanisms with an MBS program system, interpret simulation results and compare them with the results of MBS simulation programmes.

3 Contents:

- Mechanisms (definition, examples)
- Concepts in plane kinematics
- Coordinate systems, generalised coordinates
- Coercive conditions
- Examples for the standardised description of mechanisms
- Numerical solution of the kinematics
- Equations of motion of dynamics under constraints
- Lagrange multipliers
- Force and control elements
- Spatial systems
- Euler parameters
- Examples for the standardised description of spatial systems

4 Forms of teaching:

Seminar lessons with exercises and practical training on the computer

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination, combination examination, performance examination or oral examination

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

BioMechatronics M.Sc., Mechanical Engineering M.Sc. and Optimisation and Simulation M.Sc.

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr.-Ing. Rolf Naumann

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11	Other information: Literature will be announced at the beginning of the course. Literature: Rill, G.: Schaeffer, T.: Grundlagen und Methodik der Mehrkörpersimulation, Vieweg +Teubner Verlag, ISBN 978-3-8348-0888-2,2010. Haug, E.J.H: Computer-Aided Kinematics and Dynamics of Mechanical Systems, Volume 1. Basic Methods, Allyn And Bacon, ISBN 0-205-11669-8 (v.1) 1989.
12	Language: German

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Model-Based Signal Processing					MSV
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2010	180 h	6	1st or 2nd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	2	weekly hours	30	h	60	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

The students use targeted methodical procedures (modelling and simulation methods) for the development of system solutions for signal processing in complex mechatronic systems. They confidently apply the basic signal and system theory methods and means of description in context, use fundamental signal processing methods and independently design signal processing systems. The students apply the essential steps of model-based development from the idea to the design and prototypical testing to the realisation (usually in the form of an embedded system) and testing of the system in the respective development phases. They will use the MATLAB®/Simulink® tool chain for model-based development and be able to use the most important extensions and tools for coupling.

3 Contents:

Model-based system design:
Development procedure models, development methodology

Signal and systems theory supplements:
Elementary signals, system properties, time domain and frequency domain methods, system description methods, continuous-time view/discrete-time view, z-transformation, stability

Systems and methods of signal processing:
Signal processing chain, signal processing systems,
Filters, filter design, bilinear transformation, digital filters (direct constructs/wave digital filters), special methods

Aspects of realisation and implementation:
Fixed point arithmetic, scaling
Test methods
Architectures
HW/SW implementation
Application examples

4 Forms of teaching:

Seminar lessons with exercises/practical computer-based training

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5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment: Written examination, combination examination, performance examination or oral examination	
7	Prerequisite for the award of credit points: Module examination pass	
8	Application of the module (in the following study programmes) BioMechatronics M.Sc. and Optimisation and Simulation M.Sc.	
9	Importance of the grade for the final grade: according to MRPO	
10	Module coordinator: Prof. Dr.-Ing. Joachim Waßmuth	
11	Other information: Literature will be announced at the beginning of the course.	
12	Language: German	

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Multidisciplinary Modelling With Modelica					MMM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2012	180 h	6	1st or 2nd semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	2	weekly hours	30	h	60	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: Students understand the basic characteristics of object-oriented multidisciplinary modelling and simulation. In particular, they are able to develop and simulate their own physical models on the basis of the modelling language Modelica.
3	Contents: - Continuous systems - Signal and energy flow - Object diagrams as generalisation of block diagrams - Differential Algebraic Equations (DAE) - Code generation for DAEs - Discontinuous and structurally variable systems - Time and state events - Efficient handling of many switching elements - Synchronisation of events - Physical applications.
4	Forms of teaching: Seminar lessons with exercises and practicals
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Term paper, written examination, combination examination, performance examination, project work, oral examination or examination during the course
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) BioMechatronics M.Sc. and Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr. phil. Bernhard Bachmann
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Multiphysics Simulation					MPH
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2047	180 h	6	1st or 2nd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	2	weekly hours	30	h	60	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: The students can describe various physical phenomena (e.g. from the fields of structural mechanics, heat transfer, electrodynamics, acoustics, ...) with the help of partial differential equations and identify the coupling terms in multi-physics problems. They know the methodological procedure for the modelling and numerical simulation of coupled partial differential equations and can use free and commercial simulation software to solve multiphysics problems in a target-oriented manner.
3	Contents: - Definition of multiphysics via coupled partial differential equations - Treatment of typical couplings (e.g. electro-thermal WW, fluid-thermal WW, fluid-structure interaction, etc.) and their applications in practice - Numerical solution methods (especially FEM) - Best practice in modelling (CAD for simulation, appropriate discretisation, domain and boundary conditions, development of solution strategies, etc.) - Modelling and simulation using free and commercial simulation software - Application examples
4	Forms of teaching: Lecture, seminar lessons with exercises on the computer
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Project work
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Mechanical Engineering M.Sc. and Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr. rer. nat. Lars Fromme
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Project					PRO
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2017	180 h	6	1st or 2nd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	0	weekly hours	0	h	0	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	2	weekly hours	30	h	150	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: Methods and tools for the creation of a scientifically interesting and comprehensive product through independent planning and implementation.
3	Contents: - Work processes and time/project plans - Apply problem-finding and problem-solving strategies - Documentation and presentation of the project
4	Forms of teaching: Project in small groups
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination, combination examination, performance examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr.-Ing. Rolf Naumann
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Risk Management					RIM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2039	180 h	6	1st or 2nd semester	Annual (Winter)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	0	weekly hours	0	h	0	h
	Tuition in seminars	30 students	4	weekly hours	60	h	120	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2 Learning outcomes/competences:

The students know basic approaches for (especially financial) risk management in companies and have the ability to apply it in practice.

3 Contents:

- Risk concept. History of risk management
- Significance and objectives of risk management
- Legal and institutional framework
- Risk types. Risk classification
- Organisation of risk management. Risk management as a process
- Techniques for risk identification
- Mathematical modelling of risks
- Risk aggregation and assessment
- Risk management strategies and techniques
- IT support for risk management. esp. simulation of operational processes
- Risk management as a building block for optimising the value chain in companies
- Individual issues of risk management (e.g. sector-specific structuring) and case studies

4 Forms of teaching:

Seminar lessons

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written examination, oral examination or examination accompanying the course

7 Prerequisite for the award of credit points:

Module examination pass

8 Application of the module (in the following study programmes)

Optimisation and Simulation M.Sc.

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr. rer. nat. Claudia Cottin

11 Other information:

Literature will be announced at the beginning of the course. Accompanying material is provided (e.g. short script and current professional articles). Literature source for mathematical aspects of the course in particular: C. Cottin, S. Doehler: Risikoanalyse, 2. Auflage. Springer

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	Spektrum 2013.
12	Language: German

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Seminar					SE
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2013	180 h	6	1st or 2nd semester	each semester	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	0	weekly hours	0	h	0	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	4	weekly hours	60	h	120	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences:	
	Students have developed their skills in written and oral presentation of technical topics by working on a given topic from the field of optimization and simulation, summarising it in writing, and presenting it in an approx. one-hour lecture	
3	Contents:	
	Selected topics on optimisation and simulation (partly in English)	
4	Forms of teaching:	
	Independent elaboration and presentation of a given topic	
5	Participation requirements:	
	Formal:	None
	Content:	None
6	Forms of assessment:	
	In-class examination	
7	Prerequisite for the award of credit points:	
	Module examination pass	
8	Application of the module (in the following study programmes)	
	Optimisation and Simulation M.Sc.	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module coordinator:	
	Prof. Dr. Jonas Ide	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

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Simulation of Optical Systems					SOS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2016	180 h	6	1st or 2nd semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	0	weekly hours	0	h	0	h
	Exercise	20 students	2	weekly hours	30	h	60	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: Recognise the basic concepts of optical systems for use in an industrial environment. Select suitable systems for different questions. Evaluate the operational capability in the respective environment. Solve selected problems from the field of optical systems. Design optical systems. Select suitable components. Exemplary implementation of selected tasks for optical systems. Develop application programmes for optical systems. Apply typical optics and image processing libraries. Name, interpret and design interacting light-generating and light-directing components. Enable students to develop their own solutions in application areas of optical systems.
3	Contents: Selected areas of geometrical optics and wave optics. Overview of optical systems, Typical structure of selected optical systems, Industrial use of optical systems. Camera concepts: Interfaces, sensor principles, spectral sensitivity, optical sensors and measurement technology, optical device technology, imaging systems of sensor technology, two- and three-dimensional data acquisition, illumination principles, optics design and simulation.
4	Forms of teaching: Seminar lessons with accompanying exercise
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Written examination, combination examination, performance examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr.-Ing. Reinhard Kaschuba
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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System Simulation					SYS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2009	180 h	6	1st or 2nd semester	Annual (Summer)	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students	2	weekly hours	30	h	60	h
	Tuition in seminars	30 students	2	weekly hours	30	h	60	h
	Exercise	20 students	0	weekly hours	0	h	0	h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students	0	weekly hours	0	h	0	h

2	Learning outcomes/competences: The students know the basic methods for modelling (complex) technical systems and can apply these to new problems. They know how to prepare the models created and implement them on common system simulators, such as Matlab/Simulink. They can also plan simulation experiments systematically and carry them out in a targeted manner. Furthermore, they are able to assess the opportunities, limits and problems of a numerical simulation as well as analyse the results professionally.
3	Contents: - Introduction (definitions, types of simulation, process models, goals) - Modelling methods (balance-space based, formalisms for mech./electri. syst., cross-disciplinary techniques, experimental modelling) - Model preparation for simulation (transfer to state representation, block diagram, linearisation, treatment of algebraic loops and structural singularities, descriptor form) - Simulation procedures (classification, selection criteria, num. problems) - Simulation experiments (planning, implementation and follow-up) - Application examples
4	Forms of teaching: Lectures and computer seminars
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Term paper, written examination, combination examination, performance examination, project work, oral examination or examination during the course
7	Prerequisite for the award of credit points: Module examination pass
8	Application of the module (in the following study programmes) BioMechatronics M.Sc., Mechanical Engineering M.Sc. and Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr.-Ing. Klaus Panreck
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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Elective Module: Optimisation and Simulation					WM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
9023	180 h	6	1st or 2nd semester	each semester	1 semester

1	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
	Lecture	60 students		weekly hours		h		h
	Tuition in seminars	30 students		weekly hours		h		h
	Exercise	20 students		weekly hours		h		h
	Practical or seminar	15 students	0	weekly hours	0	h	0	h
	Supervised self-study	60 students		weekly hours		h		h

2	Learning outcomes/competences:
3	Contents:
4	Forms of teaching:
5	Participation requirements:
	Formal:
	Content:
6	Forms of assessment:
7	Prerequisite for the award of credit points:
8	Application of the module (in the following study programmes) Optimisation and Simulation M.Sc.
9	Importance of the grade for the final grade:
10	Module coordinator: Prof. Dr.-Ing. Rolf Naumann
11	Other information:
12	Language: German

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