Appendix B:

Module catalogue

for the study programme Mechanical Engineering (M.Sc.)

Automation Systems					AUS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2005	180 h	6	1st or 2nd sem.	Annual (Winter)	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
	Seminar lessons	30 students	1	weekly hours	15	h	30	h
	Exercise	20 students	0	weekly hours	0	h	0	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: Advanced knowledge of modern computer-aided measurement and automation systems. Students are qualified to identify and structure requirements for automation systems, to design and synthesise practical solutions, and to evaluate and critically compare their own and other people's solutions.
3	Contents: Control engineering: Description and design of linear controls in the time domain (state space) and frequency domain (action plan algebra, Laplace transform). Nonlinear systems: Linearisation and harmonic balance. Theory of discrete-time and discrete-value systems Sensors and actuators: Process measurement technology. Electric drive technology, converters as actuators. Digital communication technology (bus systems). Formal design and description methods, especially Petri nets. Introduction to special languages for programming (PLC and Microcontroller) and hardware synthesis (VHDL).
4	Forms of teaching: Lecture, seminar lessons and practical course
5	Participation requirements: Formal: None Content: None
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 Mechanical Engineering (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr.-Ing. Sebastian Hoffmann
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Fibre Composites					FVW
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2001	180 h	6	1st or 2nd sem.	Annual (Winter)	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
	Seminar lessons	30 students	1	weekly hours	15	h	30	h
	Exercise	20 students	0	weekly hours	0	h	0	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:

The students identify and evaluate the possibilities of implementing constructive lightweight construction through the use of fibre composites. They will learn about the special anisotropic mechanical properties and the special failure behaviour of fibre composites and can use this knowledge for an initial evaluation of the possible applications. Building on this, they learn the calculation methodology for fibre composite components and how to apply it to simple components. With the knowledge of the strength criteria, it is now possible for them to evaluate the use of fibre composites in practice. Furthermore, they learn about selected manufacturing processes and select special test methods that are important for fibre composite materials.

3 Contents:

- Characteristics of constructive lightweight design
- Structure of fibre composites (fibre and matrix types)
- Special properties and applications of fibre composite plastics
- Micromechanics: mechanical behaviour of unidirectionally reinforced single layers
- Macromechanics: mechanical behaviour of multilayer laminates
- Classic laminate theory
- Strength criteria for static, multi-axial loads
- Fatigue behaviour of fibre composite plastics
- Special features of joining technology and materials testing
- Applications / Hybrid materials

4 Forms of teaching:

Lecture, seminar lessons and practical course

5 Participation requirements:

Formal:	None
Content:	None

6 Forms of assessment:

Written exam, project work or oral exam

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.)

9 Importance of the grade for the final grade:

according to MRPO

10 Module coordinator:

Prof. Dr.-Ing. Thomas Kordisch

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

Finite Elements 2					FE2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2003	180 h	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	2	weekly hours	30	h	60	h
	Seminar lessons	30 students	1	weekly hours	15	h	30	h
	Exercise	20 students	0	weekly hours	0	h	0	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 learn the theoretical and practical basics of the finite element method for analysing non-linear, thermal and dynamic behaviour	
3	Contents:	
	Nonlinear materials, strain hardening models, contact modelling, thermal analysis, instability, time integration, modal analysis, fibre composite materials, fracture mechanics	
4	Forms of teaching:	
	Lecture, seminar lessons and practical course	
5	Participation requirements:	
	Formal:	None
	Content:	Finite elements elastostatics, machine dynamics
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)	
	Mechanical Engineering (M.Sc.)	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module coordinator:	
	Prof. Dr.-Ing. Paul Diekmann	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

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

Management Skills					MMK
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2006	180 h	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	2	weekly hours	30	h	60	h
	Seminar lessons	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
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

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

Multi-Body Simulation					MKS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2011	180 h	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	2	weekly hours	30	h	60	h
	Seminar lessons	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

11	Other information: Literature will be announced at the beginning of the course. Literature: Rill, G.:.: Schaeffer, T.: "Grundlagen und Methodik der Mehrkörper-simulation", 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

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

Computational Fluid Dynamics 2					CFD2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2008	180 h	6	1st or 2nd sem.	Annual (Winter)	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
	Seminar lessons	30 students	1	weekly hours	15	h	30	h
	Exercise	20 students	0	weekly hours	0	h	0	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: The students have advanced knowledge in computational fluid dynamics (CFD). Students are able to simulate unsteady and turbulent flows and interpret the results. Students are familiar with current research topics in the field of CFD.
3	Contents: Expansion of the theoretical foundations: Balance equations of fluid mechanics, finite volume method, extension of the Navier Stokes equations by the energy equation, basics of turbulence, turbulence models. Commercial tools: Simulation of turbulent flows with a commercial CFD programme, such as STAR CCM+ or ANSYS CFX. Software development: Implementation of a simple CFD programme in a higher programming language for a non-isothermal laminar flow.
4	Forms of teaching: Lecture, seminar lessons and practical course
5	Participation requirements: Formal: None Content: Content of the lecture CFD 1 (1187)
6	Forms of assessment: Written examination or 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.)
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr. rer. nat. Martin Petry
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Project Module 1					MPR1
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2007	180 h	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
	Seminar lessons	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 are able to work on scientific problems from the field of mechanical engineering within the framework of a project.	
3	Contents:	
	Familiarisation with current research and development topics, project management, documentation and presentation of results.	
4	Forms of teaching:	
	Seminar lessons	
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.)	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module coordinator:	
	Prof. Dr. rer. nat. Martin Petry	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Project Module 2					MPR2
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2002	180 h	6	1st or 2nd sem.	Annual (Winter)	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
	Seminar lessons	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 are able to work on scientific problems from the field of mechanical engineering within the framework of a project.	
3	Contents:	
	Familiarisation with current research and development topics, project management, documentation and presentation of results.	
4	Forms of teaching:	
	Seminar lessons	
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.)	
9	Importance of the grade for the final grade:	
	according to MRPO	
10	Module coordinator:	
	Prof. Dr. rer. nat. Martin Petry	
11	Other information:	
	Literature will be announced at the beginning of the course.	
12	Language:	
	German	

Systems Simulation					SYS
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2009	180 h	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	2	weekly hours	30	h	60	h
	Seminar lessons	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./electr. 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

Tribology					TRI
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
2004	180 h	6	1st or 2nd sem.	Annual (Winter)	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
	Seminar lessons	30 students	1	weekly hours	15	h	30	h
	Exercise	20 students	0	weekly hours	0	h	0	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: The students recognise tribological relationships and their significance and gain an overview of the field of knowledge. They are able to analyse and evaluate tribosystems. From the determination of influencing factors, it is possible for the students to develop suitable measures for system optimisation with regard to friction and wear. They will be able to independently work out case studies and scientifically interpret and explain them in the context of tribology.
3	Contents: Friction: Types and mechanisms of friction. Dry and media friction. Material, surface and movement influences. Wear and tear: Types and manifestations of wear. Damage mechanisms. Wear minimisation. Lubrication: Classification, characteristic values, lubrication methods. Measurement of friction, wear and lubricant parameters. Selected examples of tribological systems.
4	Forms of teaching: Lecture, seminar lessons and practical course
5	Participation requirements: Formal: None Content: None
6	Forms of assessment: Term paper, written examination, combination examination, performance examination or oral examination
7	Prerequisite for the award of credit points: Module examination pass and course assessment
8	Application of the module (in the following study programmes) Mechanical Engineering (M.Sc.)
9	Importance of the grade for the final grade: according to MRPO
10	Module coordinator: Prof. Dr.-Ing. Klaus Dürkopp
11	Other information: Literature will be announced at the beginning of the course.
12	Language: German

Elective Module					WM
Identification number:	Workload:	Credits:	Study semester:	Frequency of the offer	Duration:
9028	180 h	6	1st sem.	Annual (Summer)	1 sem.

	Course:	Planned group sizes	Scope		Actual contact time/classroom teaching		Self-study	
1	Lecture	60 students		weekly hours		h		h
	Seminar lessons	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) Mechanical Engineering (M.Sc.)
9	Importance of the grade for the final grade:
10	Module coordinator: Prof. Dr. rer. nat. Martin Petry
11	Other information:
12	Language: German