Course Handbook Mechatronics Master

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Head of Studies	
Deputy Head of Studies	
Chairman of Examination	Prof. Dr.-Ing. Barbara Hippauf
Deputy Chairman of Examination	

Qualifikation Goals of Study Programme

Mechatronics Master - mandatory courses (overview)

Module name (EN)	Code	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Electrohydraulic Drive Systems	MTM.EHA	2	2V+1U+1P	5	Prof. Dr.-Ing. Jochen Gessat
Gear Technology	MTM.GET	1	3V+1U	5	Prof. Dr.-Ing. habil. Andreas Fricke
Laser Measurement Technology and Design Methodologies	MTM.LKO	1	4V+3PA	7	Prof. Dr. Martin Löffler-Mang
Master Colloquium	MTM.MAK	3	-	1	Professoren des Studiengangs
Master Thesis	MTM.MAT	3	-	29	Professoren des Studiengangs
Mechatronic Systems	MTM.MES	1	2SU+2V	5	Prof. Dr.-Ing. Jürgen Schäfer
Motion Control Technology	MTM.BWT	2	2V+2P	5	Prof. Dr.-Ing. habil. Andreas Fricke
Numerical Methods and Statistics	MTM.NUS	1	5V+1U	7	Prof. Dr. Gerald Kroisandt
Reading, Writing and Presenting for Academic Purposes	MTM.RWP	2	2S	2	Prof. Dr. Christine Sick
Signal and Image Processing	MTM.SIG	2	4V	5	Prof. Dr.-Ing. Dietmar Brück
Simulation of Mechatronic Systems	MTM.SIM	2	4SU	5	Prof. Dr.-Ing. Jürgen Schäfer
The Finite Element Method (FEM)	MTM.FEL	1	3V	5	Prof. Dr.-Ing. Heike Jaeckels

(12 modules)

Mechatronics Master - optional courses (overview)

Module name (EN)	Code	Semester	Hours per semester week / Teaching method	ECTS	Module coordinator
Applications of Nanotechnology	MTM.NAA	-	1V+1PA	2	Prof. Dr. Walter Calles
Design of Experiments	MTM.DOE	-	2PA	3	Prof. Dr. Martin Löffler-Mang
EU Regulations for Product Development and Introduction	MTM.EUV	-	2V	2	Prof. Dr. Martin Löffler-Mang
Failure Analysis in Operational and Manufacturing Environments	MTM.SBF	-	1V	1	Prof. Dr. Walter Calles
Fundamentals of Welding - The Qualified Welding Engineer	MTM.SWT	-	6V	6	Prof. Dr. Walter Calles
Higher Analysis	MTM.HAN	-	2V+1U+1F	5	Prof. Dr. Barbara Grabowski
Introduction to Robotics	MTM.ERO	-	2V+2P	5	Prof. Dr. Martina Lehser
MINToring _ Mentor Program for Students	MTM.MNT	-	2S	2	Prof. Dr. Martina Lehser
Meteo-Sensor Technology	MTM.MET	-	1V+3PA	5	Prof. Dr. Martin Löffler-Mang
Micro- and Nanotechnology	MTM.MNA	-	2SU	3	Prof. Dr. Günter Schultes
Particle Measurement and Phase Doppler Technology	MTM.PDT	-	2V	3	Prof. Dr. Martin Löffler-Mang
Planning and Running RoboNight Workshops	MTM.PRN	-	1PA+1S	3	Prof. Dr. Martina Lehser
Quality Management	MTM.QUA	-	3V+1U	3	Prof. Dr. Benedikt Faupel

Research and Innovation Management	MTM.FIM	-	4SU	5	Prof. Dr. Günter Schultes
Simulation with Ray-Tracing	MTM.RY2	-	2V+2U	5	Prof. Dr.-Ing. Barbara Hippauf
Statistics II	MTM.STA	-	1V+1U	3	Prof. Dr. Gerald Kroisandt
Successful Professional Effectivity	MTM.SPE	-	2PA	3	Prof. Dr. Martin Löffler-Mang

(17 modules)

Mechatronics Master - mandatory courses

Electrohydraulic Drive Systems

Module name (EN): Electrohydraulic Drive Systems
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.EHA
Hours per semester week / Teaching method: 2V+1U+1P (4 hours per week)
ECTS credits: 5
Semester: 2
Mandatory course: yes
Language of instruction: German
Assessment: Written exam 90 min.
Curricular relevance: MTM.EHA Mechatronics, Master, ASPO 01.04.2020, semester 2, mandatory course MST.EHA Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 2, mandatory course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 150 hours (equivalent to 5 ECTS credits). There are therefore 105 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr.-Ing. Jochen Gessat
Lecturer: Prof. Dr.-Ing. Jochen Gessat [*updated 30.01.2019*]

Learning outcomes:
After successfully completing this submodule, students will be familiar with the architectures of electrohydraulic drive systems (e.g. valve-controlled linear and rotary drives, hydrostatic axes, variable-speed drive systems with motor pump units).

They will be able to explain the basic structure and function of the required components (pumps and motors, cylinders, electro-hydraulic valves, sensors for position/angle detection).

Students will be able to create model equations and structure diagrams of electrohydraulic drive systems.

Using predefined simulation software, students will be able to transfer the above structure diagrams into the creation of a model.

Students will be able to derive parameters for

[*updated 01.10.2020*]

Module content:

[*updated 01.10.2020*]

Recommended or required reading:

[*still undocumented*]

Gear Technology

Module name (EN): Gear Technology

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.GET

Hours per semester week / Teaching method: 3V+1U (4 hours per week)

ECTS credits: 5

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 120 min.

Curricular relevance:
MTM.GET Mechatronics, Master, ASPO 01.04.2020, semester 1, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
MTM.BWT Motion Control Technology

[*updated 22.01.2020*]

Module coordinator:
Prof. Dr.-Ing. habil. Andreas Fricke

Lecturer: Prof. Dr.-Ing. habil. Andreas Fricke

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will have mastered the prinicples of systematically designing transmission systems and can classify and characterize different types of transmission systems. They will be able to identify and describe typical movements of working bodies, dimension selected transmission types to meet given kinematic requirements and design them under kinetostatic aspects.

[*updated 01.10.2020*]

Module content:

1. Transmission systems
2. Kinematic and kinetostatic transmission system analysis
3. Design, properties and synthesis of selected types of transmission systems
   - 3.1. Gear trains
   - 3.2. Four-bar linkage
   - 3.3. Cam gear
   - 3.4. Toothed belt drives

[*updated 01.10.2020*]

Teaching methods/Media:

Lecture with integrated tutorials / lecture notes, exercises

[*updated 01.10.2020*]

Recommended or required reading:

/1/ Fricke, Günzel, Schäffer: Bewegungstechnik _ Konzipieren und Auslegen von mechanischen Getrieben. 2., überarbeitete Auflage. München: Carl Hanser Verlag 2019

/2/ Schlecht, B.: Maschinenelemente 2. Getriebe-Verzahnungen-Lagerungen. München: Pearson Studium 2010

/3/ Wittel, H.; Muhs, D.; Jannasch, D.; Voßiek, J.: Roloff/Matek - Maschinenelemente. 23.Auflage. Wiesbaden: Vieweg+Teuber Fachverlage 2017

[*updated 01.10.2020*]

Laser Measurement Technology and Design Methodologies

Module name (EN): Laser Measurement Technology and Design Methodologies
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.LKO
Hours per semester week / Teaching method: 4V+3PA (7 hours per week)
ECTS credits: 7
Semester: 1
Mandatory course: yes
Language of instruction: German
Assessment: Project work Laser Measurement Technology 70%, Design Methodologies 30%
Curricular relevance: MTM.LKO Mechatronics, Master, ASPO 01.04.2020, semester 1, mandatory course
Workload: 105 class hours (= 78.75 clock hours) over a 15-week period. The total student study time is 210 hours (equivalent to 7 ECTS credits). There are therefore 131.25 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for: MTM.PDT Particle Measurement and Phase Doppler Technology [*updated 16.09.2020*]
Module coordinator: Prof. Dr. Martin Löffler-Mang
Lecturer: Prof. Dr.-Ing. habil. Andreas Fricke Prof. Dr. Martin Löffler-Mang [*updated 08.05.2019*]

Learning outcomes:
In this module, students will gain insight into selected applications of laser measurement technology, as well as into the structured process of product development using design methodology.
After successfully completing this course, students will be able to model the structure of complex technical systems and analyze their function. They will have mastered the overall process of integrated product development and will be able to structure it in its essential phases by adapting general planning and design methods to mechatronic products.
In addition, students will have in-depth knowledge about the physical working principles of lasers and will be able to work safely with laser equipment. This will enable students to use these methods in R&D projects or for their Master thesis.

[*updated 01.10.2020*]

Module content:
Design Methodology:
- Introduction to system analysis, classification and analysis of the structure and function of technical products
- Getting to know the phases of the product life cycle and integrated product creation processes
- Methodology and methods for planning, developing and designing mechatronic products
- Working on practical examples

Laser Measurement Technology:
- Gaussian beams, coherence
- Optical resonators
- Interaction with matter, laser safety
- Holography, laser diffraction
- Laser Doppler velocimetry (LDV)
- Phase Doppler Particle Analysis (PDPA)

[*updated 01.10.2020*]

Teaching methods/Media:
In this course there will be introductory lectures in the fields of "Design Methodology" and "Laser Measurement Technology" with integrated group exercises. After a few weeks, the lectures culminate in a project in which a laser measurement technology system is developed, built and tested in independent teams according to the rules of design methodology.
As an exam, the developed systems will be presented and discussed in presentations.

[*updated 01.10.2020*]

Recommended or required reading:
Ehrlenspiel: Integrierte Produktentwicklung. Hanser
Pahl, Beitz: Konstruktionslehre. Springer
Isermann: Mechatronische Systeme. Springer
VDI 2206: Entwicklungsmethodik für mechatronische Systeme.

Löffler, Raasch: Grundlagen Mechanische Verfahrenstechnik. Vieweg
Donges, Noll: Lasermesstechnik. Hüthig
Durst, Melling, Whitelaw: Theorie und Praxis der Laser-Doppler-Anemometrie. G. Braun Karlsruhe
Litfin: Technische Optik. Springer
Ruck: Lasermethoden in der Strömungsmesstechnik. at-Fachverlag
Löffler-Mang: Handbuch Bauelemente der Optik. Hanser

[*updated 01.10.2020*]

Master Colloquium

Module name (EN): Master Colloquium
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.MAK
Hours per semester week / Teaching method: -
ECTS credits: 1
Semester: 3
Mandatory course: yes
Language of instruction: German
Assessment: n.B.
Curricular relevance: MTM.MAK Mechatronics, Master, ASPO 01.04.2020, semester 3, mandatory course MST.MAK Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 3, mandatory course MST.MAK Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 10, mandatory course
Workload: The total student study time for this course is 30 hours.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Professoren des Studiengangs
Lecturer: Professoren des Studiengangs [*updated 30.01.2019*]
Learning outcomes: Presentation of an independent academic work. [*updated 01.10.2020*]
Module content: The goal of the Master colloquium is to present and explain the results and content of the Master thesis orally and to verify that the work was done independently. [*updated 01.10.2020*]

Recommended or required reading:
Literature listed in the respective Master thesis.

[*updated 01.10.2020*]

Master Thesis

Module name (EN): Master Thesis

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.MAT

Hours per semester week / Teaching method: -

ECTS credits: 29

Semester: 3

Mandatory course: yes

Language of instruction:
German

Assessment:
Thesis

Curricular relevance:
MTM.MAT Mechatronics, Master, ASPO 01.04.2020, semester 3, mandatory course
MST.MAT Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 3, mandatory course
MST.MAT Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 10, mandatory course

Suitable for exchange students (learning agreement)

Workload:
The total student study time for this course is 870 hours.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Professoren des Studiengangs

Lecturer: Professoren des Studiengangs

[*updated 30.01.2019*]

Learning outcomes:
The student will learn to work independently under normal working conditions. They will be capable of applying the scientific, technical and non-technical skills and knowledge they have acquired and, if necessary, extending the said procedures for solving complex problems.

[*updated 01.10.2020*]

Module content:

[*updated 01.10.2020*]

Teaching methods/Media:

[*updated 01.10.2020*]

Recommended or required reading:

[*updated 01.10.2020*]

Mechatronic Systems

Module name (EN): Mechatronic Systems

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.MES

Hours per semester week / Teaching method: 2SU+2V (4 hours per week)

ECTS credits: 5

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 120 min.(70%) + term paper (30%)

Curricular relevance:
MTM.MES Mechatronics, Master, ASPO 01.04.2020, semester 1, mandatory course
MST.MES Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 1, mandatory course
MST.MES Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 8, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
MTM.SIM Simulation of Mechatronic Systems

[*updated 23.11.2020*]

Module coordinator:
Prof. Dr.-Ing. Jürgen Schäfer

Lecturer: Prof. Dr.-Ing. Jürgen Schäfer

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will be able to systematically describe, analyze and design complex mechatronic systems using system theory mthods and physical modeling. They will be familiar with the methods for handling linear and non-linear systems and be able to apply the methods to natural and mechatronic systems.

[*updated 01.10.2020*]

Module content:
- State space model (continuous-time, LTI/linear/nonlinear)
- Solving state equations in the time domain
-- Fundamental matrix
- Properties of the fundamental matrix
- Solving state equations in the frequency domain/transfer function
- Normal forms
-- Observable canonical form
-- Frobenius normal form
-- Jordan normal form
-- Similarity transformations
- Controllability and oberservability
- Discrete time systems
-- Discretization
-- Z-transform, transfer function
- State space model (discrete time)

Analysis of complex mechatronic systems e.g. from the automotive and aerospace industries, control engineering methods in mechatronics such as (exemplary),
- Driver assistance systems (ESP, ABS, ...)

- Active damping systems
- Self-sensing effects in actuator technology
- System description using Lagrange Formalism
- Artificial horizon
- Flight attitude control
- Kalman filter
- Inertial Navigation, dead reckoning, GPS support
Students will work on selected topics independently in small groups and present their findings in a workshop.

[*updated 01.10.2020*]

Recommended or required reading:

W. Roddeck, Einführung in die Mechatronik, Teubner, 2003
Schiessle (Hrsg.), Mechatronik 1 und Mechatronik 2, Vogel Fachbuch
R. Isermann, Mechatronische Systeme, Grundlagen, Springer, 1999
R. Isermann (Hrsg.), Fahrdynamik-Regelung, Vieweg, 2006
K.R. Britting, Inertial Navigations Systems Analysis, Wiley-Interscience
B. Heißing, M. Ersoy (Hrsg.), Fahrwerkhandbuch, Vieweg + Teubner, 2007
Jan Lunze, Regelungstechnik 2, Springer, 2008
Heinz Unbehauen, Regelungstechnik II, Vieweg, 2007
Otto Föllinger, Laplace-, Fourier und z-Transformation, Hüthig, 2007
Otto Föllinger, Regelungstechnik, Hüthig, 2008

[*updated 01.10.2020*]

Motion Control Technology

Module name (EN): Motion Control Technology

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.BWT

Hours per semester week / Teaching method: 2V+2P (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 120 min.

Curricular relevance:
MTM.BWT Mechatronics, Master, ASPO 01.04.2020, semester 2, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
MTM.GET Gear Technology

[*updated 22.01.2020*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. habil. Andreas Fricke

Lecturer: Prof. Dr.-Ing. habil. Andreas Fricke

[*updated 11.04.2019*]

Learning outcomes:
After successfully completing this course, students will be able to generate motions of working bodies, tools and processed goods under consideration of technological requirements and optimize them with regard to different criteria (acceleration, driving forces, vibration behavior). They will be able to develop (mechatronic) solutions for the implementation of given motions, determine their characteristics and assess their application limits. They will be able to select the appropriate calculation model for the respective phase of the development process and to implement it with the aid of analytical approaches or by using the FMD software RECURDYN.

[*updated 01.10.2020*]

Module content:
Lecture:
1. Introduction
2. Motion design
 2.1 The basics
 2.2 Describing motion sequences for transmission tasks
 2.3 Describing motion sequences for guidance tasks
3. Modeling motion systems
 3.1 Classification in the development process
 3.2 Rigid body model
 3.3 Kinetoelastic model
 3.4 Oscillatory motion model
 3.5 Introduction to multibody simulation
4. Designing motion systems
 (Case studies and exercises for the design and optimization of motion systems, taking into account design effort, necessary driving forces, required energy input)

Computer lab:
- Introduction to the mutlibody dynamics software program RECURDYN
- Tasks for the analysis and synthesis of motion systems

Lab work:
- Exercises on the design and layout of motion systems on laboratory test benches

[*updated 01.10.2020*]

Teaching methods/Media:
Lectures with integrated exercises, practical computer/lab course, lecture notes, exercises, laboratory test rigs with real transmission assemblies

[*updated 01.10.2020*]

Recommended or required reading:
/1/ Fricke, A.; Günzel, D.; Schaeffer, T.: Bewegungstechnik _ Konzipieren und Auslegen von mechanischen Getrieben. 2., überarbeitete Auflage. München: Carl Hanser Verlag. 2019
/2/ Rill, G.; Schaeffer, T.: Grundlagen und Methodik der Mehrkörpersimulation. 2. Auflage. Wiesbaden: Springer Vieweg+Teubner. 2014
/3/ Dresig, H.; Vul_fson, I.I.: Dynamik der Mechanismen. Wien: Springer-Verlag. 2013
/4/ VDI 2143, Blatt 1: Bewegungsgesetze für Kurvengetriebe. Berlin: Beuth-Verlag 1980
/5/ VDI 2149, Blätter 1 und 2: Getriebedynamik. Berlin: Beuth-Verlag 2008 bzw. 2011

[*updated 01.10.2020*]

Numerical Methods and Statistics

Module name (EN): Numerical Methods and Statistics

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.NUS

Hours per semester week / Teaching method: 5V+1U (6 hours per week)

ECTS credits: 7

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 150 min.

Curricular relevance:
MTM.NUS Mechatronics, Master, ASPO 01.04.2020, semester 1, mandatory course

Workload:
90 class hours (= 67.5 clock hours) over a 15-week period.
The total student study time is 210 hours (equivalent to 7 ECTS credits).
There are therefore 142.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:
MTM.SIM Simulation of Mechatronic Systems

[*updated 23.11.2020*]

Module coordinator:
Prof. Dr. Gerald Kroisandt

Lecturer: Prof. Dr. Gerald Kroisandt

[*updated 11.04.2019*]

Learning outcomes:
After successfully completing this part of the module, students will have mastered the use of MATLAB and Simulink.
Students will be able to represent linear and non-linear systems of equations in the programs and will be familiar with various solution methods.
They will understand the significance of the Fourier transform and will be able to calculate and evaluate given time signals independently.
Based on the theory of differentiation and integration, they will be able to differentiate and integrate functions numerically using various methods.
Afterwards, students will be able to apply the different methods to practical examples.

In the field of statistics, they will be proficient in the graphical representation of a single characteristic, as well as the calculation of various key figures.
In order to evaluate different characteristics, students will be familiar with and be able to apply different measures of correlation.
They will also be able to carry out a linear regression and know how to transform data if necessary.
In the field of probability theory, students will understand the basic concepts and have a repertoire of different distributions for various standard applications.
Finally, they will be able to use key figures of the data to infer the optimal parameters of a chosen model and derive various statements about further events (tests).

[*updated 01.10.2020*]

Module content:
I. Numerical methods
1. Working with MATLAB and Simulink (repetition)
2. Linear and nonlinear systems of equations
3. Discrete/Fast Fourier transform
4. Numerical Integration and Differentiation (continuation from Bachelor program)
5. Applications (simulation of mechatronic systems) - Mini-project

II. Statistics
1. Descriptive statistics
 1.1 Analyzing observation data
 1.2 Evaluation of several characteristics
 1.3 Linear regression
2. Principles of probability calculus
 2.1 Definition of probability
 2.2 Discrete and continuous random variables and their distributions
 2.3. Special continuous and discrete distributions
 2.4. Limit theorems
3. Inferential statistics
 3.1 Estimating probabilities, mean value and dispersion
 3.2 Confidence intervals
 3.3 Tests

[*updated 01.10.2020*]

Teaching methods/Media:
Blackboard, projector, transparencies with lecture notes

[*updated 01.10.2020*]

Recommended or required reading:
Brigham: FFT-Anwendungen, Oldenburg Verlag 1997
E. Cramer, U. Kamps: Grundlagen der Wahrscheinlichkeitsrechnung und Statistik, Springer 2017

[*updated 01.10.2020*]

Reading, Writing and Presenting for Academic Purposes

Module name (EN): Reading, Writing and Presenting for Academic Purposes
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.RWP
Hours per semester week / Teaching method: 2S (2 hours per week)
ECTS credits: 2
Semester: 2
Mandatory course: yes
Language of instruction: English
Assessment: Oral examination 30 min. and project work
Curricular relevance: MTM.RWP Mechatronics, Master, ASPO 01.04.2020, semester 2, mandatory course MST.RWP Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 2, mandatory course MST.RWP Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 9, mandatory course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Christine Sick
Lecturer: Prof. Dr. Christine Sick [*updated 30.01.2019*]
Learning outcomes: This course is based on the content from the 2nd semester of the Mechatronics/Sensor Technology Master program. After successfully completing this module, students will be able to understand demanding and complex texts on mechatronics topics by applying reading strategies. They will be familiar with the structures of scientific texts and be able to use these when writing a project report in English. Furthermore, students will be able to effectively use the advanced presentation techniques they have learned in an oral presentation in English.   [*updated 01.10.2020*]

Module content:
The content is geared to specific tasks in close coordination with representatives from the technical subjects dealt with in the project:
_ Reading and summarizing technical texts
_ Advanced reading strategies
_ Describing mechatronic and sensor systems (authentic technical texts, videos, etc.)
_ Describing cause and effect based on mechatronic systems (language of cause and effect, passive voice)
_ Introduction to academic writing (writing strategies and linguistic means)
_ Writing a project report
_ Structure of and useful phrases in English presentations
_ Presentation techniques
_ Practice presentations

[*updated 01.10.2020*]

Teaching methods/Media:
The learning goals will be achieved through integrated training of the four basic skills (listening comprehension, reading comprehension, speaking and writing) supported by the use of multimedia. Communication training will take place within the framework of learner-centered lessons in the multimedia computer language laboratory, in group work and during the F&E project.

[*updated 01.10.2020*]

Recommended or required reading:
Multimedia language learning programs, e-learning and mobile learning:
Christine Sick, unter Mitarbeit von Miriam Lange (2011): TechnoPlus English 2.0: Ein multimediales Sprachlernprogramm für Technisches und Business Englisch (Niveau B1-B2+), EUROKEY.
Christine Sick, unter Mitarbeit von Lisa Rauhoff und Miriam Wedig (seit 2016): Online Extensions zu TechnoPlus Englisch, EUROKEY.
Christine Sick (2015): htw saar TechnoPlus Englisch VocabApp (Mobile Learning Angebot insbesondere zum Grundwortschatz, alle Niveaustufen), EUROKEY.

Authentic technical texts and videos
In consultation with the respective project colleagues.

[*updated 01.10.2020*]

Signal and Image Processing

Module name (EN): Signal and Image Processing

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.SIG

Hours per semester week / Teaching method: 4V (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 150 min.

Curricular relevance:
MTM.SIG Mechatronics, Master, ASPO 01.04.2020, semester 2, mandatory course
MST.SIG Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 2, mandatory course
MST.SIG Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 9, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Dietmar Brück

Lecturer: Prof. Dr.-Ing. Dietmar Brück

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will be able to apply system theory to image processing problems. They will be familiar with the hardware and software used for image processing, in detail, and understand how they work together based on examples. Students will be able to identify and understand quality assurance tasks in the broadest sense of the term and implement them.
Practical application is the main focus here.

[*updated 01.10.2020*]

Module content:
1. One-dimensional signals in the time domain, mathematical description, representation of the associated spectra, explanation of the filter process, transition to discrete signals and to discrete spectra, sampling, FFT
2. Two-dimensional signals, extending the mathematical theory

3. Images as two-dimensional signals in the spatial domain, simple key figures for images, quantifying and rasterizing images,
4. Storing and reproducing images and related compression methods

5. Discrete image processing algorithms im the spatial domain
6. Image processing algorithms in the frequency domain

[*updated 01.10.2020*]

Recommended or required reading:
Will be announced in the course.

[*updated 01.10.2020*]

Simulation of Mechatronic Systems

Module name (EN): Simulation of Mechatronic Systems

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.SIM

Hours per semester week / Teaching method: 4SU (4 hours per week)

ECTS credits: 5

Semester: 2

Mandatory course: yes

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
MTM.SIM Mechatronics, Master, ASPO 01.04.2020, semester 2, mandatory course
MST.SIM Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 2, mandatory course
MST.SIM Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 9, mandatory course

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
MTM.MES Mechatronic Systems
MTM.NUS Numerical Methods and Statistics

[*updated 23.11.2020*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Jürgen Schäfer

Lecturer:
Prof. Dr.-Ing. Jürgen Schäfer

[*updated 23.11.2020*]

Learning outcomes:
After successfully completing this course, students will be able to use simulation tools and procedures for development, implementation and functional testing. Students are able to check and optimize the practical suitability of mechantronic systems by using simulation tools.
The objective of this course is to combine components and knowledge from different subjects. Students will learn the system concept.

[*updated 01.10.2020*]

Module content:
1. Introduction to simulation methods
2. Overview of simulation tools
3. Creating simulation models for selected mechatronic systems
4. Exemplary simulations of mechatronic systems

[*updated 01.10.2020*]

Teaching methods/Media:
MATLAB/Simulink

[*updated 01.10.2020*]

Recommended or required reading:
- Heinmann, Gerth, Popp: Mechatronik Fachbuchverlag Leipzig, 2001
- Reíner Nollau: Modellierung und Simulation technischer Systeme, Springer Verlag, 2009
- A. Weinmann: Comuputerunterstützung für Regelungsaufgaben, Springer Verlag, 1999
- Angermann, Beuschel, Rau, Wohlfarth: Matlab _ Simulink, Stateflow, Oldenbourg Verlag, 2002
- H. Bode: Matlab in der Regelungstechnik, Teubner Verlag, 1998
- W.D. Pietruszka, MATLAB und Simulink in der Ingenieurpraxis, Teubner, 2006
- C.-D. Munz, T. Westermann, Numerische Behandlung gewöhnlicher und partieller Differenzialgleichungen, Springer, 2005
- O. Zirn, S. Weikert, Modellbildung und Simulation hochdynamischer Fertigungssysteme, Springer, 2005
- H. Bode, MATLAB-SIMULINK Analyse und Simulation dynamischer Systeme, Teubner, 2006

[*updated 01.10.2020*]

The Finite Element Method (FEM)

Module name (EN): The Finite Element Method (FEM)

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.FEL

Hours per semester week / Teaching method: 3V (3 hours per week)

ECTS credits: 5

Semester: 1

Mandatory course: yes

Language of instruction:
German

Assessment:
Written exam 120 min.

Curricular relevance:
MTM.FEL Mechatronics, Master, ASPO 01.04.2020, semester 1, mandatory course
MST.FEL Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, semester 1, mandatory course

Workload:
45 class hours (= 33.75 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 116.25 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Heike Jaeckels

Lecturer: Prof. Dr.-Ing. Heike Jaeckels

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will be able to use a commercial finite element software.
They will be able to critically discuss the results of FEM calculations.

[*updated 01.10.2020*]

Module content:
- Introduction to the functions of ANSYS, the commercial FEM code
- Calculation of application examples with FEM
- 3D- structural analysis (linear problems) and thermal analysis

[*updated 01.10.2020*]

Teaching methods/Media:
Lecture with practical exercises on the PC

[*updated 01.10.2020*]

Recommended or required reading:
Jaeckels: Lecture notes
Groth et al.: FEM für Praktiker Band 1 Grundlagen

[*updated 01.10.2020*]

Mechatronics Master - optional courses

Applications of Nanotechnology

Module name (EN): Applications of Nanotechnology

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.NAA

Hours per semester week / Teaching method: 1V+1PA (2 hours per week)

ECTS credits: 2

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam and presentation

Curricular relevance:
MTM.NAA Mechatronics, Master, ASPO 01.04.2020, optional course
MAM2.1.2.18 Engineering and Management, Master, ASPO 01.10.2013, semester 1, optional course
MST.NAA Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course
MST.NAA Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Walter Calles

Lecturer: Prof. Dr. Walter Calles

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will be able to classify the topic of nanotechnology thematically and describe the special properties of nanomaterials based on physical and chemical laws.
They will be able to decide which analytical methods are suitable for specific problems.
They will be able to show the application potentials of nanotechnology by means of discrete examples and will be familiar with already established products or industrial implementations of nanotechnology.
They will be aware of special precautions regarding occupational safety measures and the general risks involved in handling small particles.

[*updated 01.10.2020*]

Module content:
_ Thematic boundaries of nanotechnology
_ Interdisciplinarity
_ Nature as a model (bionics)
_ Basic properties and applications of nanomaterials
_ Nanomaterials from a chemical and physical perspective
_ Size and interface effects based on physical and chemical theories
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Nanotechnology processes and equipment
_ Synthesis methods for nanoparticles and nanostructures
_ Differentiation between top-down and bottom-up procedures
_ Coatings technology
_ Sol-gel technology
_ Characterization methods and analysis procedures (topographic, mechanical, electronic, optical)
_

Handling nanomaterials with regard to occupational safety
_ Current studies and current state of knowledge on risks in handling nanomaterials
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Standardization in the field of nanotechnology

[*updated 01.10.2020*]

Teaching methods/Media:
Seminaristic, interactive course with lecture and workshop units. Integrated project work.
Copies and documents researched and prepared by the students themselves.

[*updated 01.10.2020*]

Recommended or required reading:
_ Uwe Hartmann: Faszination Nanotechnologie. Spektrum Akademischer Verlag. 2005. ISBN 3-8274-1658-2
_ Nanotechnologie für Dummies, R. Booker & E. Boysen, Wiley VCH Weinheim, 2006
_ Nanotechnologie, M. Köhler, Wiley VCH Weinheim, 2001
_ Niels Boeing: Nano ?! _ Die Technik des 21. Jahrhunderts Rowohlt, Berlin 2004, ISBN 3-87134-488-5.
_ Veit Bütterlin: Die Ökonomie der Nanotechnologie. Tectum Verlag, Marburg 2007, ISBN 978-3-8288-9443-3.
_ Milton Ohring, Materials Science of Thin Films _ Deposition and Structure, Academic Press 2002
_ H. Ibach und H. Lüth, Festkörperphysik. Einführung in die Grundlagen, Springer 2002
_ J. I. Gersten and F. W. Smith, The Physics and Chemistry of Materials, Wiley 2001
_ Nanoscale Materials in Chemistry, Kenneth J. Klabunde, John Wiley & Sons Inc (2001)

[*updated 01.10.2020*]

Design of Experiments

Module name (EN): Design of Experiments
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.DOE
Hours per semester week / Teaching method: 2PA (2 hours per week)
ECTS credits: 3
Semester: according to optional course list
Mandatory course: no
Language of instruction: English
Assessment: Project work
Curricular relevance: MTM.DOE Mechatronics, Master, ASPO 01.04.2020, optional course MAM.2.1.1.9 Engineering and Management, Master, ASPO 01.10.2013, semester 8, optional course MST.DOE Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course MST.DOE Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 8, optional course Suitable for exchange students (learning agreement)
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martin Löffler-Mang
Lecturer: Prof. Dr. Martin Löffler-Mang [*updated 30.01.2019*]
Learning outcomes: After successfully completing this course, students will be able to: _ articulate or explain the assumptions DOE is based on _ set up a designed experiment _ evaluate an experiment design _ analyze the results of a designed experiment _ participate in a discussion about experiment design [*updated 01.10.2020*]

Module content:

_ Measurement accuracy
_ Gage repeatability and reproducibility
_ Sum of squares and degrees of freedom
_ Analysis of varianc

[*updated 01.10.2020*]

Recommended or required reading:

[*still undocumented*]

EU Regulations for Product Development and Introduction

Module name (EN): EU Regulations for Product Development and Introduction
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.EUV
Hours per semester week / Teaching method: 2V (2 hours per week)
ECTS credits: 2
Semester: according to optional course list
Mandatory course: no
Language of instruction: German
Assessment: Written exam
Curricular relevance: MTM.EUV Mechatronics, Master, ASPO 01.04.2020, optional course MST.EUV Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course MST.EUV Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 9, optional course
Workload: 30 class hours (= 22.5 clock hours) over a 15-week period. The total student study time is 60 hours (equivalent to 2 ECTS credits). There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Martin Löffler-Mang
Lecturer: Prof. Dr. Martin Löffler-Mang [*updated 30.01.2019*]
Learning outcomes: After successfully completing this module, students will be familiar with the practical implementation of European product directives (especially the machinery directive) in the European Economic Area. They will be able to carry out conformity assessment procedures including the CE marking of products. In addition, students will be familiar with the legal consequences of putting defective products on the market or exhibiting them, as well as the legal consequences of defective products that have caused personal injury or damage to property. [*updated 01.10.2020*]

Module content:
1. EU law (basic principles)
2. Implementation of European product directives into national law
3. European Economic Area
4. Practical implementation of the EU Machinery Directive
   - Basic requirements of the EU Machinery Directive
   - Essential health and safety requirements
   - Harmonized standards and presumption of conformity
   - Requirements with applicable guidelines
   - Risk analysis
   - Technical documentation
   - Operating instructions
   - Conformity assessment procedures
   - Declaration of conformity / incorporation
   - CE marking
5. Legal consequences

[*updated 01.10.2020*]

Teaching methods/Media:
Lecture

[*updated 01.10.2020*]

Recommended or required reading:
(Maschinenrichtlinie) Machinery Directive
(Niederspannungsrichtlinie) Low Voltage Directive
(EMV-Richtlinie) EMC Directive
(Geräte- und Produktsicherheitsgesetz mit Verordnungen) Equipment and Product Safety Act with regulations

[*updated 01.10.2020*]

Failure Analysis in Operational and Manufacturing Environments

Module name (EN): Failure Analysis in Operational and Manufacturing Environments
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.SBF
Hours per semester week / Teaching method: 1V (1 hour per week)
ECTS credits: 1
Semester: according to optional course list
Mandatory course: no
Language of instruction: German
Assessment: Term paper
Curricular relevance: MTM.SBF Mechatronics, Master, ASPO 01.04.2020, optional course MAM.2.1.2.15 Engineering and Management, Master, ASPO 01.10.2013, semester 1, optional course MST.SBF Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course MST.SBF Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course
Workload: 15 class hours (= 11.25 clock hours) over a 15-week period. The total student study time is 30 hours (equivalent to 1 ECTS credits). There are therefore 18.75 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Walter Calles
Lecturer: Prof. Dr. Walter Calles [*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will be able to use their knowledge about damage mechanisms to:
- apply the guidelines and procedures for clarifying faults and material-related manufacturing difficulties
- define the procedure for the analysis and modify it based on interim results.

- select the procedures to be applied and anticipate possible results.

- interpret the results in the context of relevant literature, the circumstances and research results.

- determine the primary cause of faults.

- giveing advice on how to avoid faults.

[*updated 01.10.2020*]

Module content:
- Systematic approach according to relevant literature and VDI guidelines
- Mechanical material testing
- Metallography
- REM and EDX analysis
- X-ray diffraction
- Material databases
- Discussion about the students´ results and reports

[*updated 01.10.2020*]

Teaching methods/Media:
Interactive lecture

[*updated 01.10.2020*]

Recommended or required reading:
Broichhausen, Schadenskunde
VdEh, Erscheinungsformen von Rissen und Brüchen
Lecture notes
K.-H. Schmitt-Thomas, Schadensanalytik
VDI-Richtlinie 3822

[*updated 01.10.2020*]

Fundamentals of Welding - The Qualified Welding Engineer

Module name (EN): Fundamentals of Welding - The Qualified Welding Engineer
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.SWT
Hours per semester week / Teaching method: 6V (6 hours per week)
ECTS credits: 6
Semester: according to optional course list
Mandatory course: no
Language of instruction: German
Assessment: Written exam
Curricular relevance: MTM.SWT Mechatronics, Master, ASPO 01.04.2020, optional course, technical MAM.2.1.5.1 Engineering and Management, Master, ASPO 01.10.2013, semester 2, optional course MST.SWT Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical MST.SWT Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, technical
Workload: 90 class hours (= 67.5 clock hours) over a 15-week period. The total student study time is 180 hours (equivalent to 6 ECTS credits). There are therefore 112.5 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Walter Calles
Lecturer: Prof. Dr. Walter Calles [*updated 30.01.2019*]
Learning outcomes: In cooperation with the GSI SLV, students will acquire the theoretical knowledge required for all activities as welding engineers according to guideline DVS IIW 1170. With it they will be able to deal with questions concerning welding processes, materials and calculations. The course forms the basis for further training as a welding engineer DVS IIW. [*updated 01.10.2020*]

Module content:
- Welding processes and equipment
- Producing and designating steels
- Microstructure and properties of pure metals and iron-carbon alloys
- Heat treatment of base material and welded joint
- Structure of the welded joint
- Carbon and carbon-manganese steels
- Fine-grain structural steels
- Spare parts management
- The basics of statics of supporting structures
- Representing weld seams

[*updated 01.10.2020*]

Teaching methods/Media:
Lecture

[*updated 01.10.2020*]

Recommended or required reading:
Lecture notes GSI SLV

[*updated 01.10.2020*]

Higher Analysis

Module name (EN): Higher Analysis

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.HAN

Hours per semester week / Teaching method: 2V+1U+1F (4 hours per week)

ECTS credits: 5

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam/paper

Curricular relevance:
MTM.HAN Mechatronics, Master, ASPO 01.04.2020, optional course, technical
MST.HAN Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical
MST.HAN Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, technical

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Barbara Grabowski

Lecturer: Prof. Dr. Barbara Grabowski

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this course, students will be able to investigate force and velocity fields and other fields of physics and electrical engineering using vector analysis methods.
In addition, they will be able to describe curves and curved surfaces in R2 and R3 parametrically using curvilinear coordinate systems and calculate properties such as lengths, curvatures, areas, volumes and centers of gravity, solve complex applied extreme value problems for functions in several variables with and without constraints, and handle eigenvalues, eigenvectors, and quadrics in practical applications.

[*updated 01.10.2020*]

Module content:

1. Curves as vector-valued functions in a variable
1.1 Definition of vector functions and their geometrical meaning
1.2 Differentiation and integration of curves, Jordan curves
1.3 Tangent vectors and orientation of a curve
1.4 Case studies: Applications
2. Real-value functions in several variables
2.1 Definition, surfaces of revolution and planes
2.2 The directional derivatives, partial derivatives and their properties
2.4 The gradient, tangent plane and total differential
2.5 Extreme value search methods with and without auxiliary conditions
2.6 Case studies: practical applications
3. Coordinate transformation _ Curvilinear coordinates
3.1 The Jacobi matrix and its determinants
3.2 Coordinate lines and bases in curvilinear coordinate systems
3.3 Spherical, cylindrical and polar coordinates
3.4 Multiple integrals and integral transform
3.5. Case studies: practical applications
4. Scalar and vector fields
4.1 Definitions
4.2 Gradient of a scalar field, rotation and divergence of vector fields and their meaning
4.3 Potential fields and potential function
4.4 Del and Laplace operator and useful equations - Maxwell´s equations
4.5 Line, surface and volume integrals over scalar and vector fields and their physical meaning
4.6. Theorems of Gauss and Stokes
4.7 Case studies: applications
5. Eigenvalues and eigenvectors, quadrics
5.1 Scalar products and orthogonality
5.2. Orthogonal matrices, orthogonal bases, change between orthogonal bases
5.3. Eigenvalues and eigenvectors, eigenvalue estimation
5.4. EWe and EVe of symmetrical matrices, principal axis transformation (diagonalizability of a matrix)
5.5 Square shapes
5.6 Positive/negative (semi) definite matrices
5.7. Quadrics, normal form in R^2 and R^3
5.8 Case studies: practical applications

[*updated 01.10.2020*]

Teaching methods/Media:

Projector, smart notebook, lecture notes
PC lab: AMSeL

[*updated 01.10.2020*]

Recommended or required reading:
Papula: Mathematik für Ingenieure und Naturwissenschaftler, Band 1-3, Vieweg 2000.
MARSHDEN, TROMBA: Vektoranalysis, Spektrum, 1995.
Bourne, Kendall: Vektoranalysis, Teubner, 1966.
J.Stoer, R. Bulirsch "Einführung in die Numerische Mathematik I und II", Springer; Auflage: 5. Aufl. 2005 Springer; Auflage: 10., neu bearb. 2007.
D. Wille "Repetitorium der Linearen Algebra, Teil 1" Binomi 1997.

D. Wille, M. Holz "Repetitorium der Linearen Algebra, Teil 2" Binomi Verlag; Auflage 2, 2006.
G.Merziger, T. Wirth "Repetitorium der höheren Mathematik" Binomi; Auflage 5, 2006.
B.Griese "Übungsbuch zur Linearen Algebra: Aufgaben und Lösungen" Vieweg+Teubner Verlag; Auflage 7, überarb. u. erw. Aufl. 2011.
K.Jänich "Lineare Algebra" Springer; 11. Aufl. 2008. 2., korr. Nachdruck 2013.

[*updated 01.10.2020*]

Introduction to Robotics

Module name (EN): Introduction to Robotics

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.ERO

Hours per semester week / Teaching method: 2V+2P (4 hours per week)

ECTS credits: 5

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
KI842 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, informatics specific
MTM.ERO Mechatronics, Master, ASPO 01.04.2020, optional course, informatics specific
MST.ERO Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, informatics specific
PIM-WI20 Applied Informatics, Master, ASPO 01.10.2011, semester 1, optional course, informatics specific
MST.ERO Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, informatics specific

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser

[*updated 30.01.2019*]

Learning outcomes:
The theoretical part of this course aims at acquainting students with basic tasks and problems from the field of mobile robotics such as, self-localization, navigation, map building and route planning and providing them with the skills necessary to develop appropriate solutions.
This knowledge is then applied to a project carried out in the practical part of the module. The focus of the assignment is less the construction of a robot (Lego NXT), but rather the programming.
After successfully completing this course, students will be able to interpret sensor data intelligently and make efficient use of this data by integrating it into multiple processes.

[*updated 01.10.2020*]

Module content:
I. Theoretical part (lecture)
1. Introduction
 1.1 History and development of robotics
 1.2 Basics and definitions
 1.3 Control paradigms
2. Hardware
 2.1 Sensors used in robotics
 2.2 Actuators used in robotics
 2.3 Mechanics and robot kinematics
3. Navigation
 3.1 Mathematical principles
 3.2 Dead reckoning
 3.3 Navigation using landmarks - Examples from biology
4. Map building and route planning
 4.1 Measurement data acquisition with ultrasonic sensors
 4.2 Sensor fusion and mapping

II. Practical part (Project)
Creating a mobile robot (groups of 2 students each)
- Familiarization with the hardware and software
- Group-specific task description and project discussions
- Design, implementation and test
- Documentation
- Lecture with presentation

[*updated 01.10.2020*]

Recommended or required reading:
NEHMZOW, Ulrich, Mobile Robotik, "Eine praktische Einführung", Springer Verlag Berlin-Heidelberg, 2002
GOCKEL, DILLMANN, Embedded Robotics, "Das Praxisbuch", Elektor-Verlag, Aachen, 2005
BRÄUNL, THOMAS, Embedded Robotics, Springer Verlag, Berlin-Heidelberg, 2008, (3.Aufl.)

[*updated 01.10.2020*]

MINToring _ Mentor Program for Students

Module name (EN): MINToring _ Mentor Program for Students

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.MNT

Hours per semester week / Teaching method: 2S (2 hours per week)

ECTS credits: 2

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Participation in camps, preparation of regular work reports, composition

Curricular relevance:
MTM.MNT Mechatronics, Master, ASPO 01.04.2020, optional course
MST.MNT Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course
MST.MNT Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, semester 9, optional course

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 60 hours (equivalent to 2 ECTS credits).
There are therefore 37.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser

[*updated 30.01.2019*]

Learning outcomes:
This course is part of the "MINToring" project, which is part of a qualification initiative by the Federal Government. The Stiftung der Deutschen Wirtschaft (sdw), together with the BMBF and regional partners, have launched this project in order to get more young people interested in the MINT subjects, strengthen their interest in them and motivate them to study such subjects.
The course will provide the skills necessary to continuously advise and support young people in choosing a field of study.

After successfully completing this course, students will be able to develop and supervise workshops for project work in MINT subjects. This will help them to impart important background knowledge to their workshop participants (students up from the 11th grade and first-year university students) and to assist them when necessary.

[*updated 01.10.2020*]

Module content:
Content: _ Camp _MINT & Mehr_: Three-day workshop focusing on the interdisciplinary analysis of MINT content and the teaching of key competencies
_ MINT-Experimentier-Camp: Supervision of the three-day practice-oriented workshops in universities, non-university institutions and companies (e.g. experiments in laboratories)
_ Project work: Together with the MINTors, the MINToring participants will develop practice-oriented projects about MINT
_ Network activities: Organizing excursions, company visits, discussions with representatives from business, science and research
_ Creation of regular work reports

[*updated 01.10.2020*]

Recommended or required reading:

[*still undocumented*]

Meteo-Sensor Technology

Module name (EN): Meteo-Sensor Technology

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.MET

Hours per semester week / Teaching method: 1V+3PA (4 hours per week)

ECTS credits: 5

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Project work

Curricular relevance:
MTM.MET Mechatronics, Master, ASPO 01.04.2020, optional course, technical
MST.MET Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical
MST.MET Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, technical

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Löffler-Mang

Lecturer: Prof. Dr. Martin Löffler-Mang

[*updated 30.01.2019*]

Learning outcomes:
In the project we will build our own system according to customer requirements (cooperating companies in research projects). After successfully completing this course, students will be able to apply the methods they have learned and work independently in development projects, as well as carry out projects in interdisciplinary teams. We will focus on developing sensors for meteorological applications: weatherproof and UV-resistant, in use 24 hours a day and 7 days a week.

[*updated 01.10.2020*]

Module content:
Development of sensor technology for applications in meteorology, e.g:
Sunshine/rain sensor
Fog sensor
Inversion height detector
Snow spectrograph
Fine dust and wind sensor

[*updated 01.10.2020*]

Teaching methods/Media:
Introductory lecture
Independent project work in teams of 3-5 people

[*updated 01.10.2020*]

Recommended or required reading:
Jansen: Optoelektronik
Eichler: Laser
Young: Optik, Laser, Wellenleiter
Litfin: Technische Optik
Löffler-Mang: Optische Sensoren
Löffler-Mang: Handbuch Bauelemente der Optik

[*updated 01.10.2020*]

Micro- and Nanotechnology

Module name (EN): Micro- and Nanotechnology

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.MNA

Hours per semester week / Teaching method: 2SU (2 hours per week)

ECTS credits: 3

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Oral examination

Curricular relevance:
MTM.MNA Mechatronics, Master, ASPO 01.04.2020, optional course, technical
MST.MNA Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical
MST.MNA Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, technical

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Günter Schultes

Lecturer: Prof. Dr. Günter Schultes

[*updated 30.01.2019*]

Learning outcomes:
In this course, students will gain insight into micro- and nanotechnologies. Sensors manufactured with such technologies will be presented and discussed. Students will become familiar with the mode of operation of those sensors. In doing so, students will use their knowledge from the fields of technical mechanics and electronics.
As a result, students will be able to use such products and understand their mode of operation. A visit to a relevant manufacturing company will round off the course.

[*updated 01.10.2020*]

Module content:

1. Introduction and first application example
   - What makes "micro" different?

2. Micromechanical silicon pressure sensors
   - Operating principle and designs

3. Complex microsystems: Acceleration and rotation rate sensors
   - Operating principle and designs
   - Measurement technology

4. Technologies for the production of microstructures
   - Silicon wafer, thermal oxidation
   - Coating technologies, PVD and CVD
   - Structuring and etching processes
   - Vacuum technology

5. Nanotechnology based on an example
   - Nanoscale metal matrix layers (granular metals) in sensor technology, examples from our own research
   - Laser micromachining with ultra-short laser pulses

[*updated 01.10.2020*]

Teaching methods/Media:

Seminaristic style
Lecture with use of blackboard
Presentations
Exercises

[*updated 01.10.2020*]

Recommended or required reading:

- F. Völklein, T. Zetterer; Praxiswissen Mikrosystemtechnik, Vieweg Verlag
- T.M. Adams, R.A. Layton, Introductory MEMS, Springer Verlag
- Bosch, Sensoren im Kraftfahrzeug, Springer Verlag
- M. Glück, MEMS in der Mikrosystemtechnik, Teubner Verlag
- U. Hilleringmann, Mikrosystemtechnik, Teubner Verlag
- U. Hilleringmann, Silizium Halbleitertechnologie, Teubner Verlag
- U. Mescheder, Mikrosytemtechnik, Teubner Verlag
- M. Madou, Fundamentals of Microfabrication, CRC Press

[*updated 01.10.2020*]

Particle Measurement and Phase Doppler Technology

Module name (EN): Particle Measurement and Phase Doppler Technology

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.PDT

Hours per semester week / Teaching method: 2V (2 hours per week)

ECTS credits: 3

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Term paper

Curricular relevance:
MTM.PDT Mechatronics, Master, ASPO 01.04.2020, optional course, technical
MST.PDT Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical
MST.PDT Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, technical

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
MTM.LKO Laser Measurement Technology and Design Methodologies

[*updated 16.09.2020*]

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Löffler-Mang

Lecturer: Prof. Dr. Martin Löffler-Mang

[*updated 30.01.2019*]

Learning outcomes:
In this course, students will deepen their knowledge of particle measurement technology (Based on the "Lasermesstechnik" course), especially Laser Doppler Particle Analysis (PDPA). After successfully completing this course, students will thus have mastered the statistics of particle size distributions, the theoretical basics of PDPA and know how to handle a modern PDPA system. They will be able to independently measure and interpret a nozzle spray with PDPA.

[*updated 01.10.2020*]

Module content:
Principles of particle measurement technology:
+ Identifying particles
+ Representing quantity distributions
+ Sets and distribution functions
+ Converting distributions, moments
+ Distribution parameters
+ Approximation functions
+ Dimensional analysis
+ Methods for measuring particle size
+ Sampling, sample splitting
+ Light scattering

Introduction to and theory of PDPA:
+ Interference fringe model
+ Doppler model
+ Frequency shift and multi-components
+ Qualitative and quantitative PDPA model
+ System design
+ Examples of use
+ Current density and concentration

Practical course in the OML lab:
+ Laser power and wavelengths
+ Laser safety
+ Operating the software
+ Independent spray analysis

[*updated 01.10.2020*]

Teaching methods/Media:
Introductory lecture
Independent practical course in groups of 2-3 students
Written report including measuring instructions and data protocol

[*updated 01.10.2020*]

Recommended or required reading:
Löffler/Raasch: Mechanische Verfahrenstechnik. Vieweg
Eichler, Eichler: Laser. Springer
Young: Optik, Laser, Wellenleiter. Springer
Litfin: Technische Optik. Springer
Ruck: Lasermethoden in der Strömungsmesstechnik. at-Fachverlag
Löffler-Mang: Optische Sensoren. Vieweg + Teubner
Löffler-Mang: Handbuch Bauelemente der Optik. Hanser

[*updated 01.10.2020*]

Planning and Running RoboNight Workshops

Module name (EN): Planning and Running RoboNight Workshops

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.PRN

Hours per semester week / Teaching method: 1PA+1S (2 hours per week)

ECTS credits: 3

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Participation in 5 classes, 3 workshops, the competition + a written composition

Curricular relevance:
KI863 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, general subject
KIM-PDRW Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, general subject
MTM.PRN Mechatronics, Master, ASPO 01.04.2020, optional course, not informatics specific
MAM.2.1.1.10 Engineering and Management, Master, ASPO 01.10.2013, semester 8, optional course, not informatics specific
MST.PRN Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, not informatics specific
PIM-WN21 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
PIM-PDRW Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific
MST.PRN Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, not informatics specific

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martina Lehser

Lecturer: Prof. Dr. Martina Lehser

[*updated 30.01.2019*]

Learning outcomes:
After successfully completing this module, the students will be able to assess the special challenges involved in conducting technical
workshops and take them into regard during the preparatory phase of the workshop. They will be able to adapt the contents of the training courses to the participants´ previous knowledge and provide appropriate support in dealing with technical questions. Students will also be able to collect and prepare the knowledge necessary for the course and impart it to the workshop participants in such a manner as to fit their age groups.

In addition, they will be able to put together tasks that are specifically adapted to their target groups and will help build and consolidate their workshop participants´ knowledge in the programming and construction of robots. They will know the technical possibilities and limitations of the systems used and will be able to estimate the logistical work involved in preparing the workshop.

[*updated 24.02.2018*]

Module content:
- Conceive and formulate tasks (for workshops and competition)
- Design and implement possible solutions
- Create training materials and video tutorials
- Conduct intensive courses for small groups
- Organize and conduct 3 workshops
- Organize and supervise the competition
- Conduct follow-up work and document the experiences made

[*updated 24.02.2018*]

Teaching methods/Media:
Introductory workshop for robot programming with Mindstorm robots on computers and tablets, supervised practical course, largely independent development of the contents in groups, project discussions and workshop coaching.

[*updated 24.02.2018*]

Recommended or required reading:
- EV3-Programmierung Kurse, htw saar, EmRoLab 2017
- Programming LEGO NXT Robots using NXC, Daniele Benedettelli
- Workbook Bluetooth, HTWdS, EmRoLab 2011
- NXT-Programmierung I und II: Einführung und Fortgeschrittene, HTWdS, EmRoLab 2011

[*updated 24.02.2018*]

Quality Management

Module name (EN): Quality Management
Degree programme: Mechatronics, Master, ASPO 01.04.2020
Module code: MTM.QUA
Hours per semester week / Teaching method: 3V+1U (4 hours per week)
ECTS credits: 3
Semester: according to optional course list
Mandatory course: no
Language of instruction: German
Assessment: Project work, oral examination 15 min.
Curricular relevance: E714 Electrical Engineering, Master, ASPO 01.10.2005, semester 7, optional course MTM.QUA Mechatronics, Master, ASPO 01.04.2020, optional course MST.QUA Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course MST.QUA Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course
Workload: 60 class hours (= 45 clock hours) over a 15-week period. The total student study time is 90 hours (equivalent to 3 ECTS credits). There are therefore 45 hours available for class preparation and follow-up work and exam preparation.
Recommended prerequisites (modules): None.
Recommended as prerequisite for:
Module coordinator: Prof. Dr. Benedikt Faupel
Lecturer: Prof. Dr. Benedikt Faupel [*updated 30.01.2019*]
Learning outcomes: Students of electrical engineering will learn the basics, concepts, strategies and methods of quality management. After successfully completing this course, students will be familiar with the structure of quality assurance systems, the definition and determination of key figure systems, the meaning and objectives of quality and its realization. They will be able to apply aspects, possibilities and methods of quality management in processes and company procedures. They will be able to deal with the questions and objectives of quality management in companies. [*updated 01.10.2020*]

Module content:
- Quality management:
Structure of quality management systems
Standards and directive (DIN ISO 9000 ff. VDA 6)
- Quality manual
Definition of quality
Product quality and liability

- Quality management methods
FMEA (Failure Modes and Effects Analysis)
QFD (Quality Function Development)
DOE (Design of Experience)
SPC (Statistical Process Control)
Test planning

- Quality of business processes

- Quality organization

- Quality control loops

[*updated 01.10.2020*]

Teaching methods/Media:
Lecture notes, transparencies, blackboard, PC, projector

[*updated 01.10.2020*]

Recommended or required reading:
Pfeifer, Tilo: Vorlesung Qualitätsmanagement, RWTH Aachen

[*updated 12.03.2010*]

Research and Innovation Management

Module name (EN): Research and Innovation Management

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.FIM

Hours per semester week / Teaching method: 4SU (4 hours per week)

ECTS credits: 5

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Project, talk

Curricular relevance:
E1845 Electrical Engineering, Master, ASPO 01.10.2013, optional course, non-technical
KI832 Computer Science and Communication Systems, Master, ASPO 01.04.2016, semester 2, optional course, non-technical
KIM-FUIM Computer Science and Communication Systems, Master, ASPO 01.10.2017, semester 2, optional course, non-technical
MTM.FIM Mechatronics, Master, ASPO 01.04.2020, optional course, non-technical
MAM.2.2.19 Engineering and Management, Master, ASPO 01.10.2013, semester 2, optional course, non-technical
PIM-WN43 Applied Informatics, Master, ASPO 01.10.2011, semester 2, optional course, not informatics specific
PIM-FUIM Applied Informatics, Master, ASPO 01.10.2017, semester 2, optional course, not informatics specific
MST.FIM Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, non-technical

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Günter Schultes

Lecturer: Prof. Dr. Günter Schultes

[*updated 05.03.2021*]

Learning outcomes:
After successfully completing this module, students will be able to
develop innovative ideas in a team using creative methods and to define a new product,
quantify its degree of innovation and differentiate it from the current state of the art or direct competitors,
select a product-specific development and production environment,
divide the work required to turn the idea into a marketable product into work packages, estimate the time and cost involved and identify financing options and
present their idea, its feasibility and the market opportunities in a joint presentation in a well-founded and convincing manner.

[*updated 24.02.2018*]

Module content:
_ Definition and concept of the term innovation and the innovation process
_ Methods for finding new ideas
_ From the project idea to project management
_ Marketing I: developing strategic options
_ Marketing II: advertising, price, product features
_ Introduction to knowledge management
_ Intellectual capital as a management tool
_ State of the art, including property and patent rights
_ "Open innovation" strategic approach
_ Becoming an innovative company through organizational development

[*updated 24.02.2018*]

Teaching methods/Media:
_ Workshops
_ Group work

[*updated 20.12.2017*]

Recommended or required reading:
_ Walter Jakoby: _Projektmanagement für Ingenieure_, Springer Vieweg (2012)
_ Lothar Haberstock: _Kostenrechnung I_, Erich Schmidt Verlag

[*updated 24.02.2018*]

Simulation with Ray-Tracing

Module name (EN): Simulation with Ray-Tracing

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.RY2

Hours per semester week / Teaching method: 2V+2U (4 hours per week)

ECTS credits: 5

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam and presentation

Curricular relevance:
MTM.RY2 Mechatronics, Master, ASPO 01.04.2020, optional course, technical
MST.RY2 Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical

Workload:
60 class hours (= 45 clock hours) over a 15-week period.
The total student study time is 150 hours (equivalent to 5 ECTS credits).
There are therefore 105 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr.-Ing. Barbara Hippauf

Lecturer: Prof. Dr.-Ing. Barbara Hippauf

[*updated 30.01.2019*]

Learning outcomes:
Introduction to the development of lens systems,
beam path calculation using the matrix method,
Using the matrix method by calculating the beam path of complex lens systems.
Monte Carlo Simulation method,
Light scattering models for the description of optical surfaces: BSDF distribution function,
Lambert, Mie, Harvey - Scattering models.

[*updated 01.10.2020*]

Module content:
1. Development of an illumination system using the simulation methods discussed and scattering models to optimize the optical surfaces
2. Definition of light sources, determination of the number of source beams and optimization of simulation parameters
3. Evaluation of the simulation results based on photometric parameters (optical flux density, radiant power, solid angle, etc.)
4. Optimization of the simulated model based on the evaluation and analysis of detected and lost rays.
5. Practical tips for simplifying complex optical models.
6. Practical tips regarding feasibility, space management, time optimization and development budget.

[*updated 01.10.2020*]

Teaching methods/Media:
Lecture in PC room, simulation applications on the PC.

[*updated 01.10.2020*]

Recommended or required reading:
Lecture notes
Eugen Hecht: Optik; sechste Auflage, Oldenbourg Verlag, 2014.
Wolfgang Demtröder: Experimentalphysik 2, Elektrizität und Optik; sechste Auflage, Springer Verlag, 2013.

[*updated 01.10.2020*]

Statistics II

Module name (EN): Statistics II

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.STA

Hours per semester week / Teaching method: 1V+1U (2 hours per week)

ECTS credits: 3

Semester: according to optional course list

Mandatory course: no

Language of instruction:
German

Assessment:
Written exam and mini-project

Curricular relevance:
E2935 Electrical Engineering and Information Technology, Master, ASPO 01.04.2019, optional course, technical
E938 Electrical Engineering, Master, ASPO 01.10.2005, semester 9, optional course
E1922 Electrical Engineering, Master, ASPO 01.10.2013, optional course, technical
MTM.STA Mechatronics, Master, ASPO 01.04.2020, optional course, technical
MST.STA Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, technical
MST.STA Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, technical

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Gerald Kroisandt

Lecturer: Prof. Dr. Gerald Kroisandt

[*updated 30.01.2019*]

Learning outcomes:
Statistical methods play an important role in engineering-related studies, especially in electrical engineering, e.g. in analyzing stochastic signals and processes, planning experiments and evaluating observed data, modeling, simulating and optimizing processes, recognizing and modeling interrelationships.
Based on the basic course "Probability Calculation" (Higher Mathematics II (Part: Statistics) (E806), students in this course will learn advanced statistics methods. Mini-projects will help students learn to plan and implement the solution of more complex problems with more extensive data material using a statistics programming language (e.g. R).
After attending the lecture, they will be able to solve more complex statistical problems, as they occur in communications engineering and automation engineering, independently and in cooperation with mathematicians.

[*updated 01.10.2020*]

Module content:
1. Statistical inference methods
   1.1 Hypothesis testing
   1.2 Distribution tests
2. Generating random numbers
3. Stochastic processes
   (Definition, classification, covariance function and spectral density, cross correlation function, stationarity, ergodicity)
4. Markov chains and applications in coding and information theory
5. Poisson point process
6. Markov processes
7. Birth and death processes
8. Introduction to traffic theory (= queueing theory)
9. Introduction to the simulation of discrete systems
10. Mini-projects
11. Stochastic signals

Depending on the clientele further/other topics:

12. Introduction to further statistical methods
    12.1 Regression and correlation analysis
    12.2 Analysis of variance
    12.3 Mini-projects

[*updated 01.10.2020*]

Teaching methods/Media:
Blackboard, overhead projector, video projector, lecture notes, PC

[*updated 13.03.2010*]

Recommended or required reading:
B.Grabowski: _ ActiveMath:Statistik: Statistik für Ingenieure technischer Fachrichtungen an Fachhochschulen - e-Lerning-Buch_,
H.Weber: _Einführung in die Wahrscheinlichkeitsrechnung und Statistik für Ingenieure_
B.Grabowski:_ Lexikon der Statistik_, Elsevier-Verlag, 2001
B.Grabowski:_ Stochastik_, Lehrmaterial für das Fernstudium, Zentralstelle für Fernstudien an Fachhochschulen , ZFH Koblenz, 2004.
B.Grabowski:_ Die Simulationssprache AWESIM_, Lehrmaterial für das Fernstudium, Zentralstelle für Fernstudien an Fachhochschulen , ZFH Koblenz, 2000.
B.Grabowski:_ Mathematische Methoden bei der Simulation diskreter Systeme_,
Lehrmaterial für das Fernstudium, Zentralstelle für Fernstudien an Fachhochschulen , ZFH Koblenz, 2000.

To be found at www.htw-saarland.de/fb/gis/mathematik:
1) Vorlesungs-Skript I and II (Lecture notes I and II) - Internet
2) Formelsammlungen 1 und 2 zum Skript I und II (Formulas 1 and 2 for script I and II)
3) Übungsaufgaben und Lösungen zum Skript I und II (Exercises and solutions to script I and II)
4) Lernserver ACTIVEMATH

[*updated 01.10.2020*]

Successful Professional Effectivity

Module name (EN): Successful Professional Effectivity

Degree programme: Mechatronics, Master, ASPO 01.04.2020

Module code: MTM.SPE

Hours per semester week / Teaching method: 2PA (2 hours per week)

ECTS credits: 3

Semester: according to optional course list

Mandatory course: no

Language of instruction:
English

Assessment:
Oral exam/project work/composition

Curricular relevance:
MTM.SPE Mechatronics, Master, ASPO 01.04.2020, optional course, non-technical
MST.SPE Mechatronics and Sensor Technology, Master, ASPO 01.04.2016, optional course, non-technical
MST.SPE Mechatronics and Sensor Technology, Master, ASPO 01.10.2011, optional course, non-technical

Suitable for exchange students (learning agreement)

Workload:
30 class hours (= 22.5 clock hours) over a 15-week period.
The total student study time is 90 hours (equivalent to 3 ECTS credits).
There are therefore 67.5 hours available for class preparation and follow-up work and exam preparation.

Recommended prerequisites (modules):
None.

Recommended as prerequisite for:

Module coordinator:
Prof. Dr. Martin Löffler-Mang

Lecturer: Prof. Dr. Martin Löffler-Mang

[*updated 30.01.2019*]

Learning outcomes:
After completing this module students will be able to:
- discard negative habits and train positive habits;
- self-diagnose paradigmatic behavior and where necessary, adjust accordingly;
- realize which values and principles are important to her/him;
- develop proactive characteristics;
- specify goals and work result-oriented toward achieving these goals;
- distinguish between important and urgent matters and apply the model of time quadrants to their own time expenditure patterns;
- effectively plan tasks and activities;
- self-reflect on the above topics.

Furthermore, students will demonstrate that they have insight into:
- their personal goals, needs and principles;
- their self-image and qualities;
- their habits and behavioral patterns.

[*updated 01.10.2020*]

Module content:
Learning habits
Paradigms, centers and principles
Pro-activeness
Starting with the end in mind
Time expenditure patterns
Relationship bank accounts
Understanding and being understood
Synergies and habit modification
Time management
Self-reflection

[*updated 01.10.2020*]

Teaching methods/Media:
The assignment is to read the book independently (see reading list below), answer special questions and carry out the given tasks.
This module is worth 3 European Credits which justifies the expense of 84 hours:
_ Between 16 and 20 hours for reading the book thoroughly for the first time;
_ For each chapter about 2 hours to think about what this chapter means for you;
_ 20 hours for answering all the questions and carrying out the assignments;
_ 20 hours for completing the paper and preparing the presentation.

[*updated 01.10.2020*]

Recommended or required reading:
For this module, students must read the book _The 7 habits of highly effective teens_ written by Sean Covey. The book is meant for teenagers and adolescents, therefore it is relatively easy to read. For this module, students must read the book _The 7 habits of highly effective teens_ written by Sean Covey. This book is mainly meant for adults and professionals.

[*updated 01.10.2020*]