



**TECHNISCHE HOCHSCHULE  
OSTWESTFALEN-LIPPE**  
UNIVERSITY OF  
APPLIED SCIENCES  
AND ARTS

**Fachbereich Elektrotechnik und Technische Informatik  
Fachbereich Maschinentechnik und Mechatronik**

**Masterstudiengänge**

**Elektrotechnik (M.Sc.)**

**Information Technology (M.Sc.)**

**Mechatronische Systeme (M.Sc.)**

**Modulhandbuch**



**Department of Electrical Engineering and Computer Science  
Department of Mechanical Engineering and Mechatronics**

## **Master Degree Programs**

**Elektrotechnik (M.Sc.)**

**Information Technology (M.Sc.)**

**Mechatronische Systeme (M.Sc.)**

## Course Handbook

### Content Management

| Ver-<br>sion | Datum /<br>Date | Geändert<br>von /<br>Revised by | Änderung / Revision                                                                                                                                                                                                                              |
|--------------|-----------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.0          | 01 Sep 2016     | Rübner                          | Update der Modulbeschreibungen für MPO-MS-16, MPO-IT-16 and MPO-ET-16 / Update of course descriptions in accordance with MPO-MS-16, MPO-IT-16 and MPO-ET-16                                                                                      |
| 2.1          | 16 Jun 2017     | Rübner                          | Update LAB1 (5931) and LAB2 (5932)                                                                                                                                                                                                               |
| 2.2          | 20 Jul 2017     | Rübner                          | Update AGM (5612), DRT (5602), RMS (5607), RTS (5627) and RTM (5609)                                                                                                                                                                             |
| 2.3          | 01 Sep 2017     | Rübner                          | Update LAB1 (5931) and LAB2 (5932)                                                                                                                                                                                                               |
| 2.4          | 13 Mar 2018     | Rübner                          | Update INF (5603), DSY (5611), TEF (5624), SST (5621), IDS (5912), PAS (5913), ATA (5915), UEN (5916), ESD (5917), CDS (5918), IFU (5919), NWS (5920), ISE (5923), MAM (6616), KME (6624), MSE (6632), EVS (6644)                                |
| 2.5          | 5 Apr 2018      | Rübner                          | Update SMS (5618)                                                                                                                                                                                                                                |
| 2.6          | 13 Jun 2018     | Rübner                          | Update MBA (5906)                                                                                                                                                                                                                                |
| 2.7          | 25 Feb 2019     | Rübner                          | Update ITS (5922), LAB2 (5932), SCM (5629), SMW (5911), SCW (5620), SEM (5910)<br>New course AML (5924)                                                                                                                                          |
| 2.8          | 1 Apr 2019      | Rübner                          | Revision of the course handbook according to the renaming of the <i>Hochschule</i> from "Hochschule Ostwestfalen-Lippe – University of Applied Sciences" to "Technische Hochschule Ostwestfalen-Lippe – University of Applied Sciences and Arts" |
| 3.0          | 15.07.2019      | Rübner                          | Update der Modulbeschreibungen gemäß MPO-ET-19, MPO-IT-19 und MPO-MS-19/ Update of course descriptions in accordance with the examination regulations MPO-ET-19, MPO-IT-19 and MPO-MS-19                                                         |

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## Advanced Topics in Algorithms (ATA / 5915)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Advanced Topics in Algorithms</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Abbreviation / number:  | ATA / 5915 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Degree program:         | Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Semester:               | Full-time study: first semester; part-time study: first or third semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Responsible lecturer:   | Prof. Dr. rer. nat. Burkhard Wrenger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Lecturers:              | Prof. Dr. rer. nat. Burkhard Wrenger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Teaching type / hours:  | Lecture / 2 hours per week, Computer lab / 2 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work / homework time                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Prerequisites:          | Formal requirements: /<br>Content requirements: Software development skills using object-oriented programming languages                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Goals:                  | Competence to describe, analyze and benchmark algorithms.<br>Students of Information Technology have the skills to identify task-specific requirements and are capable of selecting suitable algorithms. They are able to implement algorithms in an object-oriented programming language.                                                                                                                                                                                                                                                                                    |
| Contents:               | Complexity and benchmarking of algorithms, optimization of algorithms, knowledge engineering and machine learning algorithms, e.g. propositional and first order logic, probabilistic state machines and hidden Markov models, rule-based systems, adaptive resonance theory algorithms; implementation of algorithms                                                                                                                                                                                                                                                         |
| Examination:            | Written examination, oral examination, written report                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Teaching media:         | Projector / charts, blackboard, simulation software, electronic media, PC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Literature:             | Sedgewick, R.: Algorithms. Pearson, 2011.<br>Cormen, T. H./Leiserson, C.E/Rivest, R.L./Stein, C: Introduction to Algorithms. MIT Press, 2nd edition, 2001. <sup>[L]</sup> <sub>[SEP]</sub><br>Dasgupta, S./Papadimitriou, C., Vazirani, U.: Algorithms. Higher Education. McGrawHill, 1st edition, 2008. <sup>[L]</sup> <sub>[SEP]</sub><br>Jones, M.T: AI Application Programming. Charles River Media, 2003.<br>Russel, S. / Norvig, P.: Artificial Intelligence - A Modern Approach. Pearson Education / Prentice Hall, 2nd edition, 2003. <sup>[L]</sup> <sub>[SEP]</sub> |

## Advanced Topics in Machine Learning (AML / 5924)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Advanced Topics in Machine Learning</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Abbreviation / number:  | AML / 5924 Version: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Degree program:         | Elektrotechnik (M.Sc.)<br>Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Semester:               | Elektrotechnik (M.Sc.): second semester<br>Information Technology (M. Sc.): full-time study: second semester,<br>part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Responsible lecturer:   | Prof. Dr. Markus Lange-Hegermann                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Lecturer:               | Prof. Dr. Markus Lange-Hegermann                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Relation to curriculum: | Compulsory optional subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Teaching type / hours:  | Mixed lecture, discussion, exercise; 4 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures and exercises) plus<br>90 hours additional student individual work / homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Prerequisites:          | Formal requirements: /<br>Content requirements: Undergraduate mathematics; knowledge of<br>probability and statistics, knowledge of programming and data struc-<br>tures                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Goals:                  | The students know and understand basic concepts of machine learn-<br>ing and are able to apply them to given problems. Students are able<br>to look for and understand additional algorithms by studying the<br>relevant literature in Machine Learning.                                                                                                                                                                                                                                                                                                                                                                                         |
| Contents:               | Foundations of mathematics, statistics, probability theory, and opti-<br>mization. Foundations of machine learning: (un)supervised learning,<br>overfitting, Ockham's razor, models. A selection of current applica-<br>tions and solutions with corresponding algorithms. The knowledge<br>about these algorithms is in part acquired by the students them-<br>selves from both textbooks and current papers.<br>Exercises are given to the students to deepen the understanding and<br>to learn to solve similar problems. These exercises are in part theo-<br>retical and in part practical and involve solving problems on a com-<br>puter. |
| Examination:            | Oral examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Teaching media:         | Projector, blackboard, papers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Literature:             | Bishop, Pattern Recognition and Machine Learning, Springer, 2007.<br>Courville, Goodfellow, Bengio, Deep Learning. MIT Press, 2016.<br>Rasmussen, Williams, Gaussian Processes for Machine Learning. MIT<br>Press, 2005.<br>Jaynes, Probability Theory: The Logic of Science. Cambridge Universi-<br>ty Press, 2003.<br>Current papers: arXiv, JMLR, NeurIPS, ICML,                                                                                                                                                                                                                                                                              |

## Anwendungsgebiete der Mechatronik (AGM / 5612)

|                              |                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Anwendungsgebiete der Mechatronik</b>                                                                                                                                                                                                                                                                                                            |
| Kurzzeichen / Fachnr.        | AGM / 5612 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                   |
| Studiengang:                 | Elektrotechnik (M. Sc.)<br>Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                          |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                         |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                      |
| Modulverantwortliche(r):     | Prof. Dr. Heinrich Uhe                                                                                                                                                                                                                                                                                                                              |
| Dozent(in):                  | Prof. Dr. H. Uhe, Prof. Dr.-Ing. T. Schulte                                                                                                                                                                                                                                                                                                         |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                             |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                     |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Übung / 2 SWS                                                                                                                                                                                                                                                                                                                  |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                         |
| Kreditpunkte:                | 5                                                                                                                                                                                                                                                                                                                                                   |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Mathematische Methoden, Elektronische Schaltungen, Mechanik und Maschinendynamik, Informatik, Kenntnisse der Regelungs- und Simulationstechnik.                                                                                                                                                                            |
| Lernziele, Kompetenzen:      | Die Studierenden können die Grundstrukturen, Funktions- und Entwicklungsprinzipien typischer, komplexer, mechatronischer Systeme nachvollziehen und alternative Lösungsansätze erstellen. Sie beherrschen die Herleitung der Lösungsansätze für neue Aufgabenstellungen.                                                                            |
| Inhalt:                      | Mechatronische Grundstrukturen und Prinzipien, ausgewählte Aktor- und Sensorkonzepte und Regelungskonzepte mechatronischer Systeme, Beispiele ausgeführter mechatronischer Systeme z.B. aus der Kraftfahrzeugtechnik, Industrieanwendungen mit Erarbeitung alternativer Lösungsansätze, Entwurf und Auslegung eines Systems oder eines Teilsystems. |
| Studien- Prüfungsleistungen: | Klausur oder mündliche Prüfung, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                              |
| Medienformen:                | Tafel, Folien/Beamer, Skript, Notebook-University-Lernplattform.                                                                                                                                                                                                                                                                                    |
| Literatur:                   | Isermann, R.: Mechatronische Systeme. Grundlagen. Springer, 2008.<br>Heimann; Gerth; Popp: Mechatronik. Hanser, 2007.                                                                                                                                                                                                                               |
| Text für Transcript:         | <b>Mechatronic Systems in Applications</b><br>Analysis of mechatronic systems or subsystems in existing applications, conceptual design according to the functional requirements of new systems.                                                                                                                                                    |

## Communication for Distributed Systems (CDS / 5918)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Communication for Distributed Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Abbreviation / number:  | CDS / 5918 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Semester:               | Elektrotechnik (M. Sc.): second semester<br>Information Technology (M. Sc.): full-time study: second semester;<br>part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Responsible lecturer:   | Prof. Dr.-Ing. Jürgen Jasperneite                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Lecturers:              | Prof. Dr.-Ing. Jürgen Jasperneite                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Relation to curriculum: | Compulsory optional subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Teaching type / hours:  | Lecture / 2 hours per week, Lab / 2 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Prerequisites:          | Formal requirements: /<br>Content requirements: /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Goals:                  | <p><b>Knowledge</b><br/>The students are able to give an overview of protocol engineering for distributed real-time systems. This includes the presented formal description techniques, discrete event simulation and the performance evaluation of computer networks.</p> <p><b>Comprehension</b><br/>The students are able to explain in detail the needed steps for a credible performance evaluation of communication systems. They are able to describe the approach of discrete event simulation for performance evaluation.</p> <p><b>Application</b><br/>The students are able to apply their knowledge to a practical case study using the DES tool omnet++.</p> |
| Contents:               | <p><b>Lecture:</b><br/>1. System theory and technologies: Basic communication concepts and patterns, services and protocols, layered communication system.<br/>2. Performance evaluation of computer networks using discrete event simulation.</p> <p><b>Lab:</b><br/>1. Exercises related to lectures<br/>2. Performance evaluation study of a communication protocol with omnetpp; output analysis and representation with Matlab or R.</p>                                                                                                                                                                                                                             |
| Examination:            | Written examination. The subject grade equals the grade of the written examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Teaching media: | Blackboard, overhead/projector, computer simulations                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Literature:     | Coulouris, G., Dollimore, J., Kindberg, T.: Distributed Systems, Concepts and Design. 4th rev. ed. Addison Wesley, 2005.<br>Jain, R.: The Art of Computer Systems Performance Analysis. Techniques for Experimental Design, Measurement, Simulation and Modeling. Wiley, 1991.<br><a href="#">Popovic</a> , M.: Communication Protocol Engineering. CRC, 2006.<br>Tanenbaum, A. S., van Steen, M.: Distributed Systems. Principles and Paradigms. 2nd rev. ed. Prentice Hall, 2006. |

## Digitale Regelungstechnik (DRT / 5602)

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:          | <b>Digitale Regelungstechnik</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Kurzzeichen / Fachnr.      | DRT / 5602 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Studiengang:               | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Semester:                  | 1. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Angebotshäufigkeit:        | Wintersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Modulverantwortliche(r):   | Prof. Dr.-Ing. T. Schulte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Dozent(in):                | Prof. Dr.-Ing. T. Schulte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Sprache:                   | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Zuordnung z. Curriculum:   | Pflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lehrform / SWS:            | Vorlesung / 2 SWS<br>Projektarbeit / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Arbeitsaufwand:            | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Kreditpunkte:              | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Voraussetzungen:           | Formal: /<br>Inhaltlich: Mathematik, Physik, Grundgebiete der Elektrotechnik, Elektronik, Informatik, Mechanik und Maschinendynamik.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Lernziele,<br>Kompetenzen: | <p>Regelungstechnisches Wissen ist für das Verständnis, die Konzeptionierung und Umsetzung mechatronischer Systeme unabdingbar, da Regelkreise entscheidend für die Dynamik der Systeme sind.</p> <p>Ziel ist, dass die Studierenden unabhängig von der Vorbildung aus den Bachelorstudiengängen ein ausreichendes Wissen über das Zusammenspiel von Regelungen und Komponenten mechatronischer Systeme haben, um bzgl. neuer Problemstellungen die Umsetzbarkeit bewerten, mögliche Risiken und wesentliche Determinanten erkennen und eigene anwendungsbezogene und praktikable Lösungsansätze entwickeln zu können.</p> <p>Gegenüber allgemeinen regelungstechnischen Aufgabenstellungen steht dabei der Bezug zum mechatronischen Gesamtsystem und seinem Entwurf im Fokus. Die Studierenden werden für eine übergreifende Gesamtsicht des mechatronischen Systems mit der Regelungstechnik als integrative Komponente/Lösung sensibilisiert.</p> |
| Inhalt:                    | <p>In der ersten Phase erfolgt eine an den individuellen Lern- und Wissensstand angepasste Vermittlung ergänzender regelungstechnischer Kenntnisse durch Seminare bzw. Vorlesungsblöcke mit dem Ziel, dass alle Studierenden in der Lage sind, digitale Regelkreise zu entwerfen und zu realisieren (Frequenzbereichsverfahren, Betragsoptimum, quasikontinuierlicher Entwurf digitaler Regler).</p> <p>In einer zweiten Phase wird in einem Vorlesungsblock auf die Besonderheiten der mechatronischen Systeme hinsichtlich der Regelungstechnik und den Zusammenhang mit dem mechatronischen Systementwurf eingegangen.</p>                                                                                                                                                                                                                                                                                                                         |

|                                 |                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | In der dritten Phase erfolgt eine Projektarbeit über ein individuell ausgegebenes Thema im Kontext der Regelung mechatronischer Systeme, bei der einerseits auf die sinnvolle und ingenieurmäßige Anwendung der erlernten regelungstechnischen Methoden und andererseits auf die adäquate Berücksichtigung des mechatronischen Gesamtsystems fokussiert wird. |
| Studien-<br>Prüfungsleistungen: | Ausarbeitung mit Kolloquium, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                           |
| Medienformen:                   | Tafel, Folien/Beamer, Skript.                                                                                                                                                                                                                                                                                                                                 |
| Literatur:                      | Föllinger, O.: Regelungstechnik. Einführung in die Methoden und ihre Anwendung. 8. Aufl. Hüthig, 1994.<br>Föllinger, O.: Nichtlineare Regelungen. Bd.1. Oldenbourg, 2001.<br>Isermann, R.: Digitale Regelsysteme. Springer, 1988.                                                                                                                             |
| Text für Transcript:            | <b>Digital Control Engineering</b><br>Goal: Design of controls for mechatronic systems.<br>Basic individual sections about digital control systems, enhanced methods of mechatronic systems control, project work.                                                                                                                                            |

## Discrete Signals and Systems (DSS / 5914)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Discrete Signals and Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Abbreviation / number:  | DSS / 5914 Version: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Degree programs:        | Elektrotechnik (M. Sc.), Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Semester:               | Elektrotechnik (M. Sc.): first semester<br>Information Technology (M. Sc.): full-time study: first semester; part-time study: first or third semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Responsible lecturer:   | Prof. Dr.-Ing. Uwe Meier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Lecturers:              | Prof. Dr.-Ing. Uwe Meier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Teaching type / hours:  | Lecture / 3 hours per week, Exercise / 1 hour per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises) plus 90 hours additional student individual work / homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Prerequisites:          | Content requirements: Continuous signals and linear systems: complex notation, FOURIER series and transformation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Goals:                  | <p>The course provides basic knowledge of how discrete signals and discrete linear time-invariant systems are characterized and analyzed. Upon completion of the course students are able to</p> <ul style="list-style-type: none"> <li>- describe sampling and reconstruction of signals,</li> <li>- use appropriate transform methods,</li> <li>- understand filtering with window functions,</li> <li>- design frequency-selective filters,</li> <li>- use simulation software for signal processing.</li> </ul> <p>After completion of the course, students are able to critically analyze signal processing problems and create appropriate solutions.</p> |
| Contents:               | <p>Repetition of time-continuous signals (energy and power signals, deterministic and random signals, cross- and auto-correlation, low-pass and band-pass signals, FOURIER and HILBERT transform, filtering with window functions, frequency-selective filters).</p> <p>Time-discrete signals (sampling theorem, discrete and fast FOURIER transform)</p> <p>Time-discrete systems (z-transform, filtering with window functions, frequency-selective filters)</p>                                                                                                                                                                                              |
| Examination:            | Written examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Teaching media:         | Projector / charts, blackboard, simulation software                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Literature:             | <p>Script with exercise problems for downloading.</p> <p>Hayes, M. H.: Schaum's Outlines. Digital Signal Processing. McGraw Hill.</p> <p>Oppenheim, A. V, Willsky, A. S.: Signals and Systems. Prentice Hall.</p> <p>Oppenheim, A. V., Schafer, R. W.: Discrete-Time Signal Processing. Prentice Hall.</p>                                                                                                                                                                                                                                                                                                                                                      |

## Embedded Systems Design (ESD / 5917)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Embedded Systems Design</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Abbreviation / number:  | ESD / 5917 Version: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Degree program:         | Elektrotechnik (M. Sc.), Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Semester:               | Elektrotechnik (M. Sc.): second semester<br>Information Technology (M. Sc.): full-time study: second semester;<br>part time-study: second or fourth semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Responsible lecturer:   | Prof. Dr.-Ing. Jürgen Jasperneite                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Lecturers:              | Dr. Holger Flatt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Relation to curriculum: | Compulsory optional subject according to the examination regulations for Elektrotechnik (M.Sc.) and Information Technology (M.Sc.) of 2019.<br>Compulsory subject according to the examination regulations for Elektrotechnik (M.Sc.) of 6 March 2018 and for Information Technology of 4 July 2018                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Teaching type / hours:  | Lecture / 2 hours per week, Exercise / 2 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Prerequisites:          | Formal requirements: /<br>Content requirements: /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Goals:                  | <p><b>Knowledge</b><br/>Students gain knowledge in the field of embedded systems. This includes generic system design aspects, sensors and actuators, micro-processor basics, HDL design, components of embedded systems, testing of embedded systems, FPGA basics, embedded software integration, and hardware-based acceleration approaches.</p> <p><b>Comprehension</b><br/>Students gain competencies in the design of embedded systems with focus on real-time issues. They are able to specify embedded systems and explore the design space according to applicational requirements as well as to implement and test embedded systems. According to the wide range of the covered topics, the students are able to understand the correlation between the different aspects of embedded system design.</p> <p><b>Application</b><br/>The students are able to apply their knowledge in order to design practical embedded systems based on FPGA technologies.</p> |
| Contents:               | <p>Lecture:</p> <p>1. Introduction to embedded systems: What are embedded systems, requirements for embedded systems, and communication ap-</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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|                 | <p>proaches?</p> <p>2. System theory and technologies: Signal processing chain, embedded processor basics, bus systems, memory concepts, external interfaces, multi- and coprocessor concepts</p> <p>3. Software concepts: code development, tool-chains, operating systems for embedded systems</p> <p>4. Application examples from the domain of industrial automation</p> <p>Lab:</p> <p>1. Exercises related to lectures</p> <p>2. Fundamentals of FPGA design</p> <p>3. Embedded FPGA-based system design including embedded CPUs</p> <p>4. Exemplary implementation of embedded software for industrial usage</p> |
| Examination:    | Written examination (1.5 hours). The course grade equals the grade of the written examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Teaching media: | Blackboard, overhead projector / projector, computer labs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Literature:     | <p>P. Marwedel: Embedded System Design. Springer, 2018.</p> <p>Hennessy, J. L.: Computer Architecture. A Quantitative Approach. Morgan Kaufmann, 2017.</p> <p>Thomas, D., Moorby, Philip: The Verilog® Hardware Description Language. Springer, 2008.</p>                                                                                                                                                                                                                                                                                                                                                               |

## Forschungsprojekt (FOP / 5632)

|                              |                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Forschungsprojekt</b>                                                                                                                                                                                                                                                                                                                                                         |
| Kurzzeichen / Fachnr.:       | FOP / 5632 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                  |
| Studiengang:                 | Elektrotechnik (M. Sc.) und Mechatronische Systeme (M. Sc.) gemäß der Prüfungsordnungen 2019                                                                                                                                                                                                                                                                                     |
| Semester:                    | 3. Semester                                                                                                                                                                                                                                                                                                                                                                      |
| Angebotshäufigkeit:          | Keine Beschränkung                                                                                                                                                                                                                                                                                                                                                               |
| Modulverantwortliche(r):     | der/die Prüfende                                                                                                                                                                                                                                                                                                                                                                 |
| Dozent(in):                  | ---                                                                                                                                                                                                                                                                                                                                                                              |
| Sprache:                     | deutsch oder englisch                                                                                                                                                                                                                                                                                                                                                            |
| Zuordnung z. Curriculum:     | Pflichtfach                                                                                                                                                                                                                                                                                                                                                                      |
| Lehrform / SWS:              | Eigenständige Bearbeitung einer forschungsorientierten Aufgabenstellung                                                                                                                                                                                                                                                                                                          |
| Arbeitsaufwand:              | 4 Monate                                                                                                                                                                                                                                                                                                                                                                         |
| Kreditpunkte:                | 30 CR                                                                                                                                                                                                                                                                                                                                                                            |
| Voraussetzungen:             | Inhaltlich: Fachliche und methodische Kompetenzen aus den Fächern der ersten zwei Semester des Master-Studiengangs                                                                                                                                                                                                                                                               |
| Lernziele, Kompetenzen:      | Die Studierenden lernen die Prozessschritte bei der Bearbeitung von Forschungsprojekten kennen, von der Antragserstellung bis zur finalen Dokumentation. Hierzu werden sie in die Bearbeitung von Teilaufgaben aktuell laufender Forschungsprojekte eingebunden. Die erworbenen Kompetenzen dienen der sich anschließenden Masterarbeit.                                         |
| Inhalt und Ablauf:           | Der fachliche Inhalt richtet sich nach der konkreten forschungsorientierten Aufgabenstellung.<br><br>Variante 1: Die Studierenden bearbeiten eine Teilaufgabe aus einem größeren Forschungsprojekt alleine oder in einem Zweierteam.<br><br>Variante 2: Die Studierenden bearbeiten mehrere Teilaufgaben aus verschiedenen Forschungsprojekten alleine oder in einem Zweierteam. |
| Studien- Prüfungsleistungen: | Ausarbeitung mit Kolloquium, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                              |
| Medienformen:                | ---                                                                                                                                                                                                                                                                                                                                                                              |
| Literatur:                   | Abhängig vom Projekt                                                                                                                                                                                                                                                                                                                                                             |
| Text für Transcript:         | <b>Research Project</b><br>Objectives: The students acquire knowledge and experience in the processing of research projects. For this, they are involved in the subtasks of current research projects.<br><br>Contents: Depend on the subject of the Research Project.                                                                                                           |

**Funktionswerkstoffe (MBFW / 6622)**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:        | <b>Funktionswerkstoffe</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Kurzzeichen / Fachnr.:   | MBFW / 6622 Stand: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Studiengang              | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Semester:                | 1. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Angebotshäufigkeit:      | Wintersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Modulverantwortliche(r): | Prof. Dr.-Ing. Jian Song                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Dozent(in):              | Prof. Dr.-Ing. Jian Song, N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Sprache:                 | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Zuordnung z. Curriculum: | Pflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lehrform / SWS:          | Vorlesung / 2 SWS<br>Übung / 1 SWS<br>Praktikum / 1 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arbeitsaufwand:          | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Kreditpunkte:            | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Voraussetzungen:         | Die Studierenden kennen den Aufbau und die Eigenschaften kristalliner und amorpher Werkstoffe und sind mit physikalischen Phänomenen, wie z.B. atomare Bindung und Struktur, thermisch aktivierten Vorgängen sowie Zustandsänderungen und Phasenumwandlungen vertraut. Sie kennen die Grundlagen der Beanspruchungsmechanismen Festigkeit und Verformung, Reibung und Verschleiß, Bruch und Ermüdung sowie Oxidation und Korrosion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Lernziele, Kompetenzen:  | Die Studierenden erwerben Kompetenzen im Bereich der physikalischen und mathematischen Beschreibung mechatronischer Funktionswerkstoffe. Sie erlangen vertiefende werkstoffwissenschaftliche Kompetenzen verknüpft mit den elementaren Grundlagen der Quantenmechanik im Hinblick auf funktionale Werkstoffe für mechatronischer Anwendungen. Durch das Verständnis für den Zusammenhang zwischen Materialeigenschaften, resultierend aus dem atomistischen Aufbau, dem Mikrogefüge und den funktionalen Anforderungen mechatronischer Bauteile, werden die Studierenden in die Lage versetzt, Ansätze für Problemlösungen zu entwickeln. Die Studierenden kennen die wissenschaftlichen Funktionsmechanismen der Werkstoffe, können die Einsatzgrenzen der Werkstoffe beurteilen und haben das Wissen um Werkstoffauswahl und Schadensanalyse. Darüber hinaus ist das Erwerben des vertieften Wissens und der Kompetenz im Themengebiet der elektrisch leitenden Basismaterialien wie Kupferlegierung, der Kunststoffe als Gehäusewerkstoffe, elektrisch leitender Oberflächenmaterialien für Korrosionsschutz sowie der Rechenmodelle für das Langzeitverhalten Ziel der Veranstaltung. Die Studierenden sind in der Lage, anspruchsvolle werkstofftechnische Probleme zu lösen bzw. Ziele für neue Werkstoffentwicklung zu definieren und Wege für deren Verwirklichung zu finden. |

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| Inhalt:                         | In diesem Modul werden Struktur- und Funktionswerkstoffe der Elektronik, Sensorik, Aktorik, Maschinen- und Feinwerktechnik im Hinblick auf ihre funktionale Anwendung behandelt. Mechanismen elektrischer Leiter- und Halbleiterwerkstoffe, Magnetwerkstoffe, sowie striktiver und piezoelektrischer Werkstoffe und Formgedächtnislegierungen werden erläutert. Die Grundlagen, Eigenschaften und mechatronische Anwendungen von Kupfer und Kupferlegierungen, Ag-, Au-, Ni-, Pd-, Sn-, Ni- und Multilayer-Oberflächen sowie Polymeren sind ebenfalls Gegenstand der Lehrveranstaltung. |
| Studien-<br>Prüfungsleistungen: | Klausur, 120 Minuten.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Medienformen:                   | Folien/Beamer, schriftliche Unterrichtsunterlagen, interaktive Lernprogramme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Literatur:                      | <ul style="list-style-type: none"> <li>•Quantenmechanik, David J. Griffiths, Pearson 2012</li> <li>•Materialwissenschaften und Werkstofftechnik, W.D. Callister und D.G.Rethwisch, Wiley-VBCH Verlag 2013</li> <li>•Werkstofftechnologie für Ingenieure, James F. Shackelford, Pearson Studium 2007</li> <li>•Polymer-Werkstoffe, Ehrenstein, G.W. Carl Hanser Verlag 2011</li> </ul>                                                                                                                                                                                                   |
| Text für Transcript:            | <b>Smart Materials</b><br>Fundamentals, properties and applications of Materials with special magnetic and electrical properties (insulator materials, electric conductors, materials for electrical contacts, materials of semiconductors and superconductors), Piezoelectric materials, Materials with shape memory and ferroelectric behaviour, Copper and copper alloys, Ag-, Au-, Ni-, Pd-, Sn- and multilayer plating, Plastics.                                                                                                                                                  |

## Industrial Software Engineering (ISE / 5923)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Industrial Software Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Abbreviation / number:  | ISE / 5923 Version: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Degree program:         | Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Semester:               | Full-time study: second semester; part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Responsible lecturer:   | Prof.'in Dr. Jessica Rubart                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Lecturers:              | Prof.'in Dr. Jessica Rubart, Volker Johannhörster                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Relation to curriculum: | Compulsory optional course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Teaching type / hours:  | Lecture / 2 hours per week, Exercises / 2 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                           |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Prerequisites:          | Formal requirements: /<br>Content requirements: /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Goals:                  | Students acquire the skills needed to manage software development projects. This includes the definition of an optimal software development method for a given project, identifying agile or disciplined practices suited for the project's specific needs. Students learn how to manage the resources needed to complete projects that meet business objectives. In addition, requirements engineering, risk management, knowledge management, and process improvement are important competence fields targeted by this course. |
| Contents:               | Industrial software development process frameworks, such as the Rational Unified Process and the agile change management approach Scrum<br>Principles of Lean Software Development<br>Process improvement with <i>Six Sigma</i><br>Designing software for and with reuse<br>Software architecture                                                                                                                                                                                                                                |
| Examination:            | Written examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Teaching media:         | Projector / charts, blackboard, software for project planning and software development                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Literature:             | Herzum, P., Sims, O.: Business Component Factory: A Comprehensive Overview of Component-Based Development for the Enterprise. OMG / John Wiley, 2000.<br>Poppendieck, M. and T.: Implementing Lean Software Development, Addison-Wesley, 2007.<br>Pyzdek, T., Keller, P. A.: The Six Sigma Handbook. 3rd ed. New York: McGraw-Hill, 2009.<br>Sommerville, I.: Software Engineering. Ninth edition. Pearson, 2010.<br><a href="#">Schwaber, K.</a> : Agile Project Management with Scrum. <a href="#">Microsoft Press</a> , 2004. |

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|  | Yacoub, S. M., Ammar, H. H.: Pattern-Oriented Analysis and Design: Composing Patterns to Design Software Systems. Addison-Wesley, 2003. |
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## Information Fusion (IFU / 5919)

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|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Information Fusion</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Abbreviation / number:  | IFU / 5919 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Semester:               | Elektrotechnik (M. Sc.): second semester<br>Information Technology (M. Sc.): full-time study: second semester,<br>part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Responsible lecturer:   | Prof. Dr.-Ing. Volker Lohweg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Lecturer:               | Prof. Dr.-Ing. Volker Lohweg, scientific assistant/s                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Relation to curriculum: | Compulsory optional subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Teaching type / hours:  | Lecture / 3 hours per week, Lab / 1 hour                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Prerequisites:          | Formal requirements: /<br>Content requirements: Mathematics for undergraduates, Statistics, Signals and Systems or System Modeling and Analysis, Image Analysis or Digital Image Processing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Goals:                  | <b>Analyse:</b> The students are able to discuss sensor and information fusion concepts as well as methodologies.<br><b>Evaluate:</b> Furthermore, they are able to operationalize mathematical models in information fusion.<br><b>Create:</b> Students are also able to apply these concepts to real life scenarios, like machine conditioning.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Contents:               | Information Fusion identifies the concept of combining data from different information sources, such as sensors or human experts. The conceptual strategy is based on obtaining new or more certain information by data combination. In numerous applications it is not possible to capture all necessary information or features by a single sensor source. In such cases more sensors and additive experts' know-how can generate more precise data regarding different real world systems, e.g. robots, machines and equipment, data experts systems, cognitive systems and so on. The following topics are highlighted:<br>sensory signal representation<br>fusion methods<br>fusion models / multi-sensor fusion<br>human-centric models<br>probability theory incl. Bayes decision trees<br>Dempster-Shafer theory<br>Fuzzy set theory<br>possibility theory, real world examples |

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| Examination:    | Programming project with presentation (30 min.) or written exam, graded                                                                                                                                                                                                                                                                                                                                                                                    |
| Teaching media: | Projector, blackboard, charts, lecture notes "Information Fusion"                                                                                                                                                                                                                                                                                                                                                                                          |
| Literature:     | Bosse, E.: Concepts, Models, and Tools for Information Fusion. Artech, 2007.<br>Campos, F.: Decision Making in Uncertain Situations. An Extension to the Mathematical Theory of Evidence. Diss. Boca Raton, 2006.<br>Shafer, G.: A Mathematical Theory of Evidence. Princeton University Press, 1976.<br>Thomas, C. (Ed.): Sensor Fusion. Foundation and Applications. InTech, 2011.<br>Thomas, C. (Ed.): Sensor Fusion and Its Applications. Sciyo, 2010. |

## Innovation and Development Strategies (IDS / 5912)

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Innovation and Development Strategies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Abbreviation / number:  | IDS / 5912 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)<br>Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Semester:               | Elektrotechnik (M. Sc.), Mechatronische Systeme (M. Sc.): second semester<br>Information Technology (M. Sc.): full-time study: second semester, part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                      |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Responsible lecturer:   | Prof. Dr.-Ing. Volker Lohweg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Lecturers:              | Prof. Dr.- Ing. Volker Lohweg, Prof. Dr. phil. Reinhard Doleschal, Dr. Christian Helmig, Dipl.-Ing. ETH Johannes Schaede, Prof. Dr. rer. pol. Andreas Welling                                                                                                                                                                                                                                                                                                                                                                   |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Relation to curriculum: | Compulsory course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Teaching type / hours:  | Lecture / 2 hours per week, Exercises / 1 hour per week, Lab / 1 hour per week                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time and/or group work time, depending on selection of themes                                                                                                                                                                                                                                                                                                                                 |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Prerequisites:          | Elementary management skills                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Goals:                  | <p><b>Analyse:</b> The students are able to understand and discuss about fundamental principles and methods for innovation and development processes based on intercultural R&amp;D strategies, knowledge management, portfolio analysis, risk management, and patent strategies for international companies.</p> <p><b>Evaluate:</b> Students are able to evaluate e.g. patent applications and patents.</p> <p><b>Create:</b> Furthermore, they are able to operationalize concepts e.g. on building international teams.</p> |

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|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Contents:       | <p>Intercultural management:<br/>What is culture? Cultural behavior, International R&amp;D teams</p> <p>Knowledge management:<br/>What is company knowledge? How to handle knowledge? Knowledge distribution strategies</p> <p>Development processes:<br/>Portfolio analysis, risk analysis, FMEA, processes for mass products, processes for single products</p> <p>Patent management:<br/>What are patents, patents applications, trademarks? How to read patents? Patent processing</p>                                                                                                                                                                                                                         |
| Examination:    | Oral examination and written report                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Teaching media: | Projector projector, whiteboard / blackboard, papers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Literature:     | <p>Davenport, T. H., Prusak, L: Working Knowledge. How Organizations Manage What They Know. Harvard, 1997.</p> <p>Eversheim, W. (Ed.): Innovation Management for Technical Products. RWTH Edition. Springer, 2008.</p> <p>Jacob, N.: Intercultural Management. MBA Masterclass. Kogan Page, 2003.</p> <p>Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company. How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, 1995.</p> <p>Rapaille, C.: The Culture Code. Random House, 2006.</p> <p>Stim, R.: Patent, Copyright and Trademark. A Desk Reference to Intellectual Property Law. Nolo, 2009.</p> <p>Vose, D.: Risk Analysis. A Quantitative Guide. 3rd ed. Wiley, 2008.</p> |

## Intelligentes Testen und Optimieren (ITO / 5635)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:               | <b>Intelligentes Testen und Optimieren</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Kurzzeichen / Fachnummer:       | ITO / 5635 Version: 15.07.2019j                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Studiengang:                    | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Semester:                       | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Angebotshäufigkeit:             | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Modulverantwortliche(r):        | Prof. Dr. Rainer Rasche                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Dozent(in):                     | Prof. Dr. Rainer Rasche                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Sprache:                        | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Zuordnung z. Curriculum:        | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Lehrform / SWS:                 | Vorlesung / 2 SWS Seminar / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Arbeitsaufwand:                 | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Kreditpunkte:                   | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Voraussetzungen:                | Mathematische Methoden                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Lernziele,<br>Kompetenzen:      | <p>Die Studierenden erwerben Grundkenntnisse über Methoden, Probleme und Strukturen beim Optimieren und Testen von mechatronischen Systemen. Bei komplexen mechatronischen Systemen (z. B. Autonomes Fahren, alternative Antriebe) reicht oft ein rein anforderungsbasiertes Testen nicht aus, so dass iterative Verfahren zum Einsatz kommen müssen, die auch bereits vorliegende Testergebnisse miteinbeziehen und damit neue Tests erzeugen.</p> <p>Die Studierenden lernen dabei, Optimierungs- und Testprobleme im Hinblick auf ihre für die Lösbarkeit relevanten Eigenschaften zu klassifizieren und geeignete Algorithmen auszuwählen. Sie sind insbesondere sensibilisiert, dass Testen und Optimieren Ressourcen benötigen (Hardware, Rechenzeit, Personal etc.) und kennen den Zielkonflikt zwischen Genauigkeit und Aufwand.</p> |
| Inhalt:                         | Behandlung von Methoden der Sensitivitätsanalyse, Mehrgrößenoptimierungsverfahren und der statistischen Versuchsplanung (Design of Experiments). Darstellung der Verfahren in einer für den Ingenieur anschaulichen und transparenten Form, Anwendung auf praktische Problemstellungen aus den Bereichen Autonomes Fahren, alternative Antriebe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Studien-<br>Prüfungsleistungen: | Klausur, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Medienformen:                   | Tafel, Folien/Beamer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Literatur:                      | <p>Saltelli, A.; Andres, T.; Ratto, M. et al.: Global sensitivity analysis: The Primer. Kluwer Academic Publishers, Boston, 2002</p> <p>Hillermeier, C.: Nonlinear Multiobjective Optimization - A Generalized Homotopy Approach. Birkhäuser, Basel, 2001</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Text für Transcript:            | <p><b>Intelligent Testing and Optimization</b></p> <p>The students learn to classify optimization and test problems with regard to their properties relevant for solvability and to select suitable algorithms. They are particularly sensitized that testing and optimizing resources (hardware, computing time, personnel, etc.) are limited and</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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|  | they know the trade-off between accuracy and effort. |
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## Intelligent Technical Systems (ITS / 5922)

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| Course name:            | <b>Intelligent Technical Systems</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Abbreviation / number:  | ITS / 5922 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Semester:               | Elektrotechnik (M. Sc.): second semester,<br>Information Technology (M. Sc.): full-time study: second semester;<br>part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                  |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Responsible lecturer:   | N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lecturers:              | N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Relation to curriculum: | Compulsory optional course                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Teaching type / hours:  | Lecture / 2 hours per week, Exercises / 2 hours                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                         |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Prerequisites:          | Formal requirements: /<br>Content requirements: Basic knowledge of algorithms and programming.                                                                                                                                                                                                                                                                                                                                                                                                 |
| Goals:                  | The students are able to understand and implement algorithms from the field of artificial intelligence. These algorithms are applied to the intelligent planning, configuration, diagnosis and optimization of technical systems. The main application area is industrial automation.                                                                                                                                                                                                          |
| Contents:               | Block I: System Analysis: Models for diagnosis, finite state machine, discrete models, ODE-based models, physical, DAE-based and hybrid models (e.g. Modelica), simulation of these models <sup>[1]</sup><br>Block II: System Diagnosis: Algorithms for anomaly detection and diagnosis<br>Block III: System Configuration and Planning: Propositional logic, predicate logic, temporal logic, probabilistic logic, ontologies <sup>[1]</sup> block, algorithms for configuration and planning |
| Examination:            | Written examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Teaching media:         | Projector / charts, blackboard, simulation software                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Literature:             | Cellier, F; Kofman, E: Continuous System Simulation. Springer, 2010.<br>Russel, S.; Norvig, P.: Artificial Intelligence. A Modern Approach. Prentice Hall, 2009.<br>Tan, P. N.; Steinbach, M; Kumar, V.: Introduction to Data Mining. Pearson, 2013.                                                                                                                                                                                                                                           |

## Lab Project 1 (LAB1 / 5931)

|                         |                                                                                                                                                                                                                                                                                                                         |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Lab Project 1</b>                                                                                                                                                                                                                                                                                                    |
| Abbreviation / number:  | LAB1 / 5931 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                      |
| Degree Program:         | Information Technology (M. Sc.) according to the examination regulations of 4 July 2018                                                                                                                                                                                                                                 |
| Semester:               | Full-time study: first semester; part-time study: first or third semester                                                                                                                                                                                                                                               |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                             |
| Responsible lecturer:   | Prof. Dr. rer. nat. Burkhard Wrenger (ATA), Prof. Dr.-Ing. Uwe Meier (DSS), Prof. Dr.-Ing. Jürgen Jasperneite (ESD), Prof. Dr. rer. nat. Stefan Heiss (PAS), Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker (UEN)                                                                                                |
| Lecturers:              | Prof. Dr. rer. nat. Burkhard Wrenger (ATA), Prof. Dr.-Ing. Uwe Meier (DSS), Prof. Dr.-Ing. Jürgen Jasperneite (ESD), Prof. Dr. rer. nat. Stefan Heiss (PAS), Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker (UEN)                                                                                                |
| Language:               | English                                                                                                                                                                                                                                                                                                                 |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                      |
| Teaching type / hours:  | In accordance with the requirements of the compulsory courses ATA, DSS, ESD, PAS and UEN.                                                                                                                                                                                                                               |
| Students' workload:     | 150 hours in total.                                                                                                                                                                                                                                                                                                     |
| ECTS credits:           | 5 in total.                                                                                                                                                                                                                                                                                                             |
| Prerequisites:          | LAB1 complements the compulsory courses ATA, DSS, ESD, PAS and UEN. Prerequisites for LAB1 are hence identical with the ones listed in the module descriptions of these courses.                                                                                                                                        |
| Goals:                  | In LAB1, the compulsory courses ATA, DSS, ESD, PAS and UEN are complemented by exercises that give students numerous opportunities for hands-on experiences in central fields of information technology. LAB1 addresses both professional and methodological competencies by focusing on substantive areas of practice. |
| Contents:               | See module descriptions of ATA, DSS, ESD, PAS and UEN.                                                                                                                                                                                                                                                                  |
| Examination:            | Written examination, oral examination                                                                                                                                                                                                                                                                                   |
| Teaching media:         | Projector / charts, blackboard, simulation software                                                                                                                                                                                                                                                                     |
| Literature:             | See module descriptions of ATA, DSS, ESD, PAS and UEN.                                                                                                                                                                                                                                                                  |

## Lab Project 2 (LAB2 / 5932)

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| Course name:            | <b>Lab Project 2</b>                                                                                                                                                                                                                                                                                                                   |
| Abbreviation / number:  | LAB2 / 5932 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                     |
| Degree program:         | Information Technology (M. Sc.) according to the examination regulations of 4 July 2018                                                                                                                                                                                                                                                |
| Semester:               | Full-time study: second semester; part-time study: second or fourth semester                                                                                                                                                                                                                                                           |
| Responsible lecturer:   | Prof. Markus Lange-Hegermann (AML), Prof. Dr.-Ing. Jürgen Jasperneite (CDS), Prof.'in Dr. Jessica Rubart (ISE), Prof. Dr.-Ing. Volker Lohweg (IFU), Prof. Dr. rer. nat. Stefan Heiss (NWS), Prof. Dr.-Ing. Thomas Korte (SWE)                                                                                                          |
| Lecturers:              | Prof. Markus Lange-Hegermann (AML), Prof. Dr.-Ing. Jürgen Jasperneite (CDS), Prof.'in Dr. Jessica Rubart (ISE), Prof. Dr.-Ing. Volker Lohweg (IFU), Prof. Dr. rer. nat. Stefan Heiss (NWS), Prof. Dr.-Ing. Thomas Korte (SWE)                                                                                                          |
| Language:               | English                                                                                                                                                                                                                                                                                                                                |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                                     |
| Teaching type / hours:  | In accordance with the requirements of the compulsory elective courses CDS, IFU, NWS, ISE, ITS and SWE. Students have to select 4 out of these 6 courses.                                                                                                                                                                              |
| Students' workload:     | 120 hours in total.                                                                                                                                                                                                                                                                                                                    |
| ECTS credits:           | 4 in total.                                                                                                                                                                                                                                                                                                                            |
| Prerequisites:          | LAB2 complements the compulsory elective courses CDS, IFU, NWS, ISE, ITS and SWE. Prerequisites for LAB2 are hence identical with the ones listed in the module descriptions of these courses.                                                                                                                                         |
| Goals:                  | In LAB2, the compulsory elective courses CDS, IFU, NWS, ISE, ITS and SWE are complemented by exercises that give students numerous opportunities for hands-on experiences in central fields of information technology. LAB 2 addresses both professional and methodological competencies by focusing on substantive areas of practice. |
| Contents:               | See module descriptions of CDS, IFU, NWS, ISE, ITS and SWE.                                                                                                                                                                                                                                                                            |
| Examination:            | Written examination, oral examination                                                                                                                                                                                                                                                                                                  |
| Teaching media:         | Projector / charts, blackboard, simulation software                                                                                                                                                                                                                                                                                    |
| Literature:             | See module descriptions of CDS, IFU, NWS, ISE, ITS and SWE.                                                                                                                                                                                                                                                                            |

## Management Skills and Business Administration (MBA / 5906)

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| Course name:            | <b>Management Skills and Business Administration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Abbreviation / number:  | MBA / 5906 Version: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)<br>Mechatronische Systeme (M.Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Semester:               | Elektrotechnik (M. Sc.), Mechatronische Systeme (M. Sc.) and the full-time version of Information Technology (M.Sc.) according to the examination regulations of 2019: first semester<br><br>Part-time version of Information Technology (M.Sc.) according to the examination regulations of 2019: first or third semester<br><br>Elektrotechnik (M. Sc.) according to the examination regulations of 6 March 2018, Mechatronische Systeme (M. Sc.) according to the examination regulations of 16 April 2018 and the full-time version of Information Technology (M.Sc.) according to the examination regulations of 4 July 2018: third semester<br><br>Part-time version of Information Technology (M.Sc.) according to the examination regulations of 4 July 2018: fifth semester |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Responsible lecturer:   | Prof. Dr. Andreas Welling                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Lecturers:              | Prof. Dr. Andreas Welling, Prof. Dr. Dieter Dresselhaus, Prof. Dr. Gunther Olesch, Gisbert Hodde, Ina Eltner                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Relation to curriculum: | Elektrotechnik (M. Sc.), Mechatronische Systeme (M. Sc.) and Information Technology (M.Sc.) according to the examination regulations of 2019: compulsory subject<br><br>Information Technology (M.Sc.) according to the examination regulations of 4 July 2018: compulsory subject<br><br>Elektrotechnik (M. Sc.) according to the examination regulations of 6 March 2018 and Mechatronische Systeme (M. Sc.) according to the examination regulations of 16 April 2018: compulsory optional subject                                                                                                                                                                                                                                                                                |
| Teaching type / hours:  | Seminar / 4 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Students' workload:     | 150 hours = 65 hours confrontation time (lectures, exercises, and labs) plus 85 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Prerequisites:          | Formal requirements: /<br>Content requirements: /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Goals:                  | The students<br>- are familiar with financing and accounting models of medium-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | <p>sized enterprises and know the meaning of outside financing</p> <ul style="list-style-type: none"> <li>- know methods and instruments of business management, human resource management, marketing and controlling</li> <li>- are familiar with means and methods of strategic business management</li> <li>- understand strategies and models of internationalization and globalization</li> <li>- know the basics of project management and have already done projects themselves</li> <li>- are able to handle modern media and have gained experience in presentations</li> <li>- are familiar with aspects of teamwork / team roles</li> <li>- have developed strategies to deal with stress and conflicts</li> <li>- know the conventions for writing a letter of application and a CV</li> <li>- are familiar with typical questions in job interviews and typical tasks in assessment centers.</li> </ul> |
| Contents:       | Accounting, financing, balanced scorecard, marketing and research, strategic business management, leadership, internationalization, communication skills, presentation skills, rhetorical skills, job advertisements & job applications, intercultural studies, teamwork, creativity, how to deal with conflicts, how to deal with stress, how to lead a discussion, organization of projects, time management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Examination:    | Presentation with grade                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Teaching media: | PowerPoint and projector, metaplan board, flipchart                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Literature:     | <p>Hammer, M., Champy, J.: Re-engineering the Corporation. Harper Business, 1993.</p> <p>Kaplan, R. S., Norton, D. P.: The Balanced Scorecard. Harvard, 1996.</p> <p>Kotter, J. P.: Leading Change. Harvard, 1996</p> <p>Lynch, R. L.: Strategic Management. Pearson, 2012.</p> <p>Porter, M. P.: The Competitive Advantage of Nations. Macmillan, 1990.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## Maschinendynamik und Simulation (MDS / 6700)

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:         | <b>Maschinendynamik und Simulation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Kurzzeichen / Fachnummer: | MDS / 6700 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Studiengang:              | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Semester:                 | 1. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Modulverantwortliche(r):  | Prof. Dr.-Ing. Theo Kiesel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Dozent(in):               | Prof. Dr.-Ing. Theo Kiesel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Sprache:                  | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Zuordnung z. Curriculum:  | Pflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Lehrform / SWS:           | Vorlesung / 2 SWS<br>Übung / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arbeitsaufwand:           | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Kreditpunkte:             | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Voraussetzungen:          | Grundkenntnisse in Mechanik entsprechend der Zulassungsvoraussetzungen für den Studiengang.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Lernziele, Kompetenzen:   | Die Studierenden sind in der Lage, das dynamische Verhalten von technischen Systemen zu berechnen, sowohl per Handrechnung als auch unter Verwendung professioneller Simulationstools. Sie sind sich bewusst, dass jedes technische System potentiell schwingungsfähig ist, und kennen die wichtigsten Schwingungsphänomene in Theorie und Praxis. Sie können Berechnungsergebnisse interpretieren und ggf. geeignete Verbesserungsmaßnahmen (z.B. zur Schwingungsminderung) anbringen.                                                                                                                                                                                                                                                                                                                                                                                                  |
| Inhalt:                   | <p><b>Maschinendynamik:</b></p> <ul style="list-style-type: none"> <li>- Modellbildung technischer Systeme</li> <li>- Schwingungstechnische Grundlagen</li> <li>- Lineare Schwinger mit einem Freiheitsgrad</li> <li>- Lineare Schwinger mit mehreren Freiheitsgraden</li> <li>- Maßnahmen zur Schwingungsminderung</li> <li>- Nichtlineare Phänomene</li> </ul> <p><b>Simulation:</b></p> <ul style="list-style-type: none"> <li>- Theoretische Grundlagen und Ablauf von Simulationsstudien</li> <li>- Simulation technischer Systeme mit Beispielen aus dem Bereich Mechanik, Elektro-, Regelungs- und Fahrzeugtechnik, Hydraulik</li> <li>- Visualisierung und Interpretation der Ergebnisse, Validierung durch Handrechnung. Vergleich zwischen numerischen und analytischen Berechnungen.</li> <li>- Aufzeigen typischer „Fallstricke“ bei der Anwendung der Simulation</li> </ul> |
| Studien-                  | Klausur oder mündliche Prüfung oder benotete Ausarbeitung oder                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prüfungsleistungen:  | benotete Bildschirmarbeit. Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Medienformen:        | Skript, Folien, Übungen mit Rechneinsatz, Beamer, Tafel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Literatur:           | <p>Dresig H., Holzweißig F.: Maschinendynamik, 12. Aufl., Springer, 2016</p> <p>Beitelschmidt M., Dresig H. (Hrsg.): Maschinendynamik – Aufgaben und Beispiele, Springer, 2016</p> <p>Dresig H., Fidlin A.: Schwingungen mechanischer Antriebssysteme, 3. Aufl., Springer Vieweg, 2014</p> <p>Gasch R., u.a.: Strukturdynamik – Diskrete Systeme und Kontinua, 2. Aufl., Springer Vieweg, 2012</p> <p>Glöckler, M.: Simulation Mechatronischer Systeme, 2. Aufl., Springer Vieweg, 2018</p> <p>Pietruszka, W. D.: MATLAB® und Simulink® in der Ingenieurpraxis, 4. Aufl., Springer 2014</p> |
| Text für Transcript: | <p><b>Engineering Dynamics and Simulation</b></p> <p>Dynamics, basic problems in engineering dynamics, parameter definition, fundamentals of vibration, presentation of vibrations in the time / frequency domain, balancing, frequency-response functions of technical systems, amplitude and phase characteristics, free / forced vibration, torsional vibration, one-/multi-degree of freedom systems, vibration damping, simulation methods.</p>                                                                                                                                        |

## Masterarbeit (MAA / -)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                       |
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| Modulbezeichnung:               | <b>Masterarbeit</b>                                                                                                                                                                                                                                                                                                                                                                   |
| Kurzzeichen / Fachnummer:       | MAA / - <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                        |
| Studiengang:                    | Elektrotechnik (M. Sc.)<br>Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                            |
| Semester:                       | 4. Semester                                                                                                                                                                                                                                                                                                                                                                           |
| Angebotshäufigkeit:             | Keine Beschränkung                                                                                                                                                                                                                                                                                                                                                                    |
| Modulverantwortliche(r):        | der/die Erstprüfende                                                                                                                                                                                                                                                                                                                                                                  |
| Dozent(in):                     | ---                                                                                                                                                                                                                                                                                                                                                                                   |
| Sprache:                        | deutsch oder englisch                                                                                                                                                                                                                                                                                                                                                                 |
| Zuordnung z. Curriculum:        | Pflichtfach                                                                                                                                                                                                                                                                                                                                                                           |
| Lehrform / SWS:                 | Eigenständige Bearbeitung einer praxis-relevanten Aufgabenstellung mit wissenschaftlichem Neuwert                                                                                                                                                                                                                                                                                     |
| Arbeitsaufwand:                 | 4 Monate                                                                                                                                                                                                                                                                                                                                                                              |
| Kreditpunkte:                   | 30 CR                                                                                                                                                                                                                                                                                                                                                                                 |
| Voraussetzungen:                | Alle Pflichtfächer, Forschungsprojekt                                                                                                                                                                                                                                                                                                                                                 |
| Lernziele,<br>Kompetenzen:      | Lernziel der Masterarbeit ist das fächerübergreifende Anwenden vertiefend erarbeiteter Einzelkenntnisse und -fähigkeiten unter Anwendung wissenschaftlicher Methoden. Dadurch werden praktische Erfahrungen erworben und die Methoden- und Fachkompetenz im Bereich der wissenschaftlichen Anwendung insbesondere mit Blick auf die jeweils definierten Aufgabenstellungen erweitert. |
| Inhalt:                         | Richtet sich nach der konkreten ingenieurmäßigen Aufgabenstellung.                                                                                                                                                                                                                                                                                                                    |
| Studien-<br>Prüfungsleistungen: | Schriftlicher Bericht, benotet.<br>Die Note entspricht der Note für die Masterarbeit.                                                                                                                                                                                                                                                                                                 |
| Medienformen:                   | ---                                                                                                                                                                                                                                                                                                                                                                                   |
| Literatur:                      | ---                                                                                                                                                                                                                                                                                                                                                                                   |
| Text für Transcript:            | <b>Master's Thesis</b><br>Objectives: Applying and learning scientific methods; gaining experience in practical work; being able to manage a larger project.<br>Contents: See title of Master's Thesis.                                                                                                                                                                               |

## Master's Thesis (MAT / -)

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|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Master's Thesis</b>                                                                                                                                                                                                                                                                                                         |
| Abbreviation / number:  | MAT / - <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                 |
| Degree program:         | Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                |
| Semester:               | Full-time study: fourth semester; part-time study: seventh or eighth semester                                                                                                                                                                                                                                                  |
| Frequency of the offer: | No restriction                                                                                                                                                                                                                                                                                                                 |
| Responsible lecturer:   | The initial examiner                                                                                                                                                                                                                                                                                                           |
| Lecturers:              | ---                                                                                                                                                                                                                                                                                                                            |
| Language:               | English                                                                                                                                                                                                                                                                                                                        |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                             |
| Teaching type / hours:  | Independent processing of a practice-relevant task with a new scientific value                                                                                                                                                                                                                                                 |
| Duration:               | 4 months                                                                                                                                                                                                                                                                                                                       |
| ECTS credits:           | 30 CR                                                                                                                                                                                                                                                                                                                          |
| Prerequisites:          | All compulsory subjects, Research Project                                                                                                                                                                                                                                                                                      |
| Goals:                  | The aim of the Master's Thesis is the interdisciplinary application of in-depth individual knowledge and skills using scientific methods. Thus, practical experience is gained and the methodical and professional competence in the field of scientific application is extended, especially with regard to the defined tasks. |
| Contents:               | Depends on the respective engineering project                                                                                                                                                                                                                                                                                  |
| Examination:            | Written report, graded.<br>The grade corresponds to the grade for the Master's Thesis.                                                                                                                                                                                                                                         |
| Teaching media:         | ---                                                                                                                                                                                                                                                                                                                            |
| Literature:             | ---                                                                                                                                                                                                                                                                                                                            |

## Mathematische Methoden (MAM / 6616)

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| Modulbezeichnung:            | <b>Mathematische Methoden</b>                                                                                                                                                                                                                                                           |
| Kurzzeichen / Fachnummer:    | MAM / 6616 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                       |
| Studiengang:                 | Elektrotechnik (M. Sc.)<br>Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                              |
| Semester:                    | 1. Semester                                                                                                                                                                                                                                                                             |
| Angebotshäufigkeit:          | Wintersemester                                                                                                                                                                                                                                                                          |
| Modulverantwortliche(r):     | Prof.'in Dr. Cornelia Lerch-Reisp                                                                                                                                                                                                                                                       |
| Dozent(in):                  | Prof.'in Dr. Cornelia Lerch-Reisp, Prof. Dr.-Ing. Thomas Schulte                                                                                                                                                                                                                        |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                 |
| Zuordnung z. Curriculum:     | Pflichtfach                                                                                                                                                                                                                                                                             |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Übung / 2 SWS                                                                                                                                                                                                                                                      |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                             |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                    |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Mathematikkenntnisse entsprechend der Zulassungsvoraussetzungen für den Studiengang.                                                                                                                                                                           |
| Lernziele, Kompetenzen:      | Aufbauend auf den Kenntnissen aus dem Bachelor-Studium erwerben die Studierenden profunde mathematische Kenntnisse für den ingenieurwissenschaftlichen Beruf. Sie beherrschen sicher die mathematische Anwendung und Modellbildung in ingenieur- und naturwissenschaftlichen Bereichen. |
| Inhalt:                      | Fourier-, Laplace- und z-Transformationen und deren Anwendungen, ausgewählte Differentialgleichungen, Wahrscheinlichkeit, Zufallsvariable, Zufallsprozesse, einführend angewendet auf stationäre stochastische Signale in linearen zeitinvarianten Systemen.                            |
| Studien- Prüfungsleistungen: | Klausur oder mündliche Prüfung, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                  |
| Medienformen:                | Tafel, Folien/Beamer, Skript, Programmierung am PC, Animationen am PC.                                                                                                                                                                                                                  |
| Literatur:                   | Ray Wiley, C. / Barrett, L. C.: Advanced Engineering Mathematics. 6. Aufl. McGraw, 1995.                                                                                                                                                                                                |
| Text für Transcript:         | <b>Mathematical Methods</b><br>Integral transformations, especially Laplace and Fourier transformations, probability, random variables, stochastic processes, introductively applied to stationary stochastic signals in linear time-invariant systems.                                 |

## Mechatronischer Systementwurf (MSE / 6632)

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| Modulbezeichnung:            | <b>Mechatronischer Systementwurf</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Kurzzeichen / Fachnummer:    | MSE / 6632 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Studiengang:                 | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. Thomas Schulte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Dozent(in):                  | Dr.-Ing. Guido Stollt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Zuordnung z. Curriculum:     | Pflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Übung / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Voraussetzungen:             | Formal:<br>Inhaltlich: Mathematische Methoden, Mechanik und Maschinendynamik, Informatik, Kenntnisse der Regelungstechnik.                                                                                                                                                                                                                                                                                                                                                                                            |
| Lernziele, Kompetenzen:      | Die Studierenden beherrschen auf Basis der VDI-Richtlinie 2206 die domänenübergreifende Entwicklungsmethodik für mechatronische Systeme. Sie können die in der VDI-Richtlinie 2206 angegebenen Vorgehensweisen in der industriellen Praxis anwenden.<br><br>Die Studierenden haben Grundkenntnisse zur Theorie der Modellierung und Simulation mechatronischer Systeme und können diese auf typische Beispiele anwenden.                                                                                              |
| Inhalt:                      | Mechatronische Grundstrukturen und Prinzipien, domänenübergreifende Entwicklungsmethodik für mechatronische Systeme, Problemlösungszyklus als Mikrozyklus, V-Modell als Makrozyklus, Prozessbausteine für wiederkehrende Arbeitsschritte, Entwurf und Auslegung eines Systems oder eines Teilsystems.<br><br>Grundlagen zur Erstellung mathematischer Modelle von mechatronischen Systemen sowie Grundlagen der Simulation wie Simulationsalgorithmen, implizite, explizite Verfahren, Stabilitätsbetrachtungen, usw. |
| Studien- Prüfungsleistungen: | Klausur oder mündliche Prüfung, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Medienformen:                | Tafel, Folien/Beamer, Skript, Notebook-University-Lernplattform.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Literatur:                   | VDI 2206: Entwicklungsmethodik für mechatronische Systeme. Beuth, 2003.<br>Isermann, R.: Mechatronische Systeme. Grundlagen. Springer, 1999.<br>Gipser, M.: Systemdynamik und Simulation. Teubner, 1999.                                                                                                                                                                                                                                                                                                              |
| Text für Transcript:         | <b>Design of Mechatronic Systems</b><br>Methodological approach to the design of mechatronic systems according to VDI guideline 2206 based on the actual machine design of a                                                                                                                                                                                                                                                                                                                                          |

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|  | mechatronic system or subsystem. Simulation and Modelling of mechatronic Systems. |
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**Mikro- und Nanotechnik (MNT / 6643)**

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| Modulbezeichnung:            | <b>Mikro- und Nanotechnik</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Kurzzeichen / Fachnummer:    | MNT / 6643 Stand: 15.07.2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Studiengang:                 | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. Jian Song                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Dozent(in):                  | Prof. Dr.-Ing. Jian Song                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Praktikum / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Mathematik: Stochastik, Physik: Optik, Technische Mechanik: Statik, Dynamik, Elektrotechnik: AC, DC, elektrische u. magnetische Felder, Messtechnik: elektr. u. DMS                                                                                                                                                                                                                                                                                                     |
| Lernziele, Kompetenzen:      | Die Studierenden haben grundlegendes und vertieftes Wissen im Bereich der Mikrosystemtechnik. Die Studierenden kennen die wichtigen physikalischen Grundlagen, Arbeitsmethoden und Anwendungstechniken der Mikrosystemtechnik als anspruchsvolle, neue und zukunfts-trächtige Querschnittstechnologie und können diese anwenden.                                                                                                                                                                 |
| Inhalt:                      | Ausgehend von den physikalischen Grundlagen werden die Systemintegration (Bsp. Airbag-System, ESP), Anwendungen (Aktor und Kraftsensor aus Piezokeramik, Aktor aus Formgedächtnis-Legierungen, elektrostatische Antriebe, Abstandssensoren usw.) und Fertigungstechnologien (CVD, PVD, Lithografie, Ätzverfahren, LIGA, Kleben und Bonden) mikrotechnischer Sensorik und Aktorik erläutert. In Laborversuchen werden die Technologien und Arbeit mit der Mikrosystemtechnik näher kennengelernt. |
| Studien- Prüfungsleistungen: | Klausur, 120 Minuten.<br>Die Note entspricht der Note für das Modu                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Medienformen:                | Tafel, Folien/Beamer, schriftliche Lehrunterlagen.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Literatur:                   | Gerlach, G. / Dötzel, W. (1997): Grundlagen der Mikrosystemtechnik. Hanser.<br>Menz, W. / Mohr, J. (1997): Mikrosystemtechnik für Ingenieure. VCH Weinheim.<br>Mescheder, U. (2004): Mikrosystemtechnik. Teubner.<br>Vollath, D. (2008): Nanomaterials. Wiley-VCH.                                                                                                                                                                                                                               |
| Text für Transcript:         | <b>Microelectromechanical Systems and Nanotechnology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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|  | Physical fundamentals, design, manufacturing and applications of micro- and nanotechnology, sensors and actuators. |
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## Modellierung von Fluiddynamik und Energietransport (MFE / 6640)

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
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| Modulbezeichnung:            | <b>Modellierung von Fluiddynamik und Energietransport</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                   |
| Kurzzeichen / Fachnummer:    | MFE / 6640                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Stand: 15.07.2019 |
| Studiengang:                 | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. Georg Klepp                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |
| Dozent(in):                  | Prof. Dr.-Ing. Georg Klepp                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Übung / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                   |
| Voraussetzungen:             | Formal:<br>Inhaltlich: Mathematik: Differential- und Integralrechnung, Vektoranalysis numerische Methoden für Gleichungslöser, Erhaltungssätze der Mechanik, Wärmetransport                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
| Lernziele, Kompetenzen:      | Methoden der mathematischen Modellierung und numerischen Berechnung von Strömungen und Wärmetransport. Eigenständiges Aufstellen von Simulationsmodellen. Auswahl und sichere Handhabung geeigneter Berechnungsmethoden und Simulationsprogramme. Eigenständige Durchführung von Simulationsrechnungen. Kritische Einordnung eigener und fremder Simulationsergebnisse                                                                                                                                                                                                                                                                                  |                   |
| Inhalt:                      | Grundgleichungen für Strömung und Wärmetransport (Erhaltungsgleichungen, Navier-Stokes-Gleichungen). Physikalische Transportphänomene bei Strömung und Wärmetransport (Diffusion, freie und erzwungene Konvektion, Strahlung). Transportgleichung. Ansätze zur Modellierung. Methoden der Diskretisierung (Finite Differenzen, Finite Volumen, Finite Elemente). Lösen von Gleichungssystemen (direkte Löser, iterative Löser, Konvergenz). Gittergenerierung (strukturiert, unstrukturiert, Hexaeder, Tetraeder). Rand- und Anfangsbedingungen. Anwendung auf technische Systeme: Simulation von Strömungen, Kühlung von Bauteilen, Energietransport.. |                   |
| Studien- Prüfungsleistungen: | Ausarbeitung.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
| Medienformen:                | Tafel, Folien/Beamer, Skript.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |
| Literatur:                   | Bird / Stewart / Lightfoot (2007): Transport Phenomena. Wiley.<br>Peric / Ferziger (2008): Numerische Strömungsmechanik. Springer.<br>Patankar (1980): Numerical Heat Transfer and Fluid Flow, McGraw-Hill.                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |

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| Text für Transcript: | <b>Modelling of Fluid Flow and Energy Transfer</b><br>Basics of numerical simulation of fluid flow and heat transfer. Discretization schemes and numerical solution used in computational fluid dynamics (CFD). Application to mechatronic systems. |
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## Network Security (NWS / 5920)

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|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Network Security</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Abbreviation / number:  | NWS / 5920 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Semester:               | Elektrotechnik (M. Sc.): second semester<br>Information Technology: full-time study: second semester; part-time study: second or fourth semester                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Responsible lecturer:   | Prof. Dr. rer. nat. Stefan Heiss                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Lecturers:              | Prof. Dr. rer. nat. Stefan Heiss, Dr. Henning Trsek                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Relation to curriculum: | Compulsory optional subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Teaching type / hours:  | Lecture / 2 hours per week, Lab / 2 hour per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work (homework and project work)                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Prerequisites:          | Basic knowledge of networking and IP-related protocols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Goals:                  | The students acquire solid knowledge about threats to security and privacy in networked and distributed systems. Different security mechanisms specified in current network protocols are known and can be rated with respect to their applicability. The students are familiar with the most important aspects of information security management and they are able to apply them to both, Information Technology (IT) and Operational Technology (OT) environments.<br>The students carry out a detailed study of some selected security-related protocol or recently published attack (project work). |
| Contents:               | Networking applications and protocols and their vulnerabilities, IT security (aims, threats, secure programming), applied cryptography (basic mechanisms, selected algorithms and their applications), public key infrastructures (PKI), security and privacy in networked and distributed systems, transport layer security protocol (TLS), information security governance (according to ISO 27001), industrial security (IEC 62443).                                                                                                                                                                  |
| Examination:            | Written examination.<br>The course grade equals the grade of the written examination.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Teaching media:         | Lectures: computer presentations, blackboard, handouts<br>Labs: LAN/WLAN traffic and packet analysis, sniffing and spoofing tools, establishing a PKI and securing a networks using TLS                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| Literature: | Anderson, R.: Security Engineering. Wiley, 2008.<br>Campbell, T.: Practical Information Security Management. Springer, 2016.<br>Kaufman, C., Perlman, R. Speciner, M.: Network Security. Prentice Hall, 2002.<br>Paar, C., Pelzl, J.: Understanding cryptography: A textbook for students and practitioners. Springer, 2010.<br>Risitc, I.: Bulletproof SSL and TLS. Feisty Duck, 2014.<br>Stallings, W.: Cryptography and Network Security. Principles and Practice. Pearson, 2016. |
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## Photonik (PHO / 5628)

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|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Photonik</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Kurzzeichen / Fachnummer:    | PHO / 5628 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                              |
| Studiengang:                 | Elektrotechnik (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. Oliver Stübbe                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Dozent(in):                  | Prof. Dr.-Ing. Oliver Stübbe                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Lehrform / SWS:              | Vorlesung / 3 SWS<br>Übung / 1 SWS                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arbeitsaufwand:              | 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                            |
| Kreditpunkte:                | 5 CR / 150 h                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Theorie elektromagnetischer Felder, Mathematische Methoden                                                                                                                                                                                                                                                                                                                                                            |
| Lernziele, Kompetenzen:      | Basierend auf den Maxwell'schen Gleichungen werden in diesem Modul die Ausbreitungseigenschaften des Lichts als elektromagnetische Welle hergeleitet. Die Studierenden können basierend darauf optische Systeme analysieren und die erworbenen Kompetenzen auf neue Fragestellungen der Photonik anwenden. Basierend auf den erworbenen Kompetenzen können sie Systeme der Photonik hinsichtlich unterschiedlicher Fragestellungen evaluieren. |
| Inhalt:                      | Anregung, Ausbreitung und Detektion von elektromagnetischen Wellen, Geometrische Optik, Linsen, Wellengleichung, Randbedingungen, Überlagerung von Wellen, Polarisationsarten, Definition und Berechnung von Moden optischer Wellenleiter, Kopplung von Komponenten, limitierende Faktoren optischer Systeme, Vorstellung unterschiedlicher optischer Systeme, vielmodige und singlemodige optische Übertragungssysteme.                       |
| Studien- Prüfungsleistungen: | Mündliche Prüfung oder Klausur, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                         |
| Medienformen:                | Tafel, Beamer, Skript.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Literatur:                   | Bahaa, E. A. Saleh: Grundlagen der Photonik, Wiley-CH 2008.<br>Hering, E.: Photonik, Springer Verlag 2006<br>Pedrotti, F.: Optik für Ingenieure, Springer Verlag 2008.<br>Snyder, A.: Optical waveguide theorie, Springer Verlag 1984.                                                                                                                                                                                                         |
| Text für Transcript:         | <b>Photonics</b><br>Objectives: Being able to understand the principles and limitations of optical systems.<br>Contents: Geometrical optics, wave optics, lenses, boundary conditions, polarization, definition and calculation of the modes of optical systems, calculation of the transmission behavior of optical interconnection systems, application and limits of optical systems                                                        |

## Probability and Statistics (PAS / 5913)

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| Course name:            | <b>Probability and Statistics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Abbreviation / number:  | PAS / 5913 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                         |
| Degree program:         | Elektrotechnik (M. Sc.)<br>Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                |
| Semester:               | Elektrotechnik (M. Sc.): first semester<br>Information Technology (M. Sc.): full-time study: first semester; part-time study: first or third semester                                                                                                                                                                                                                                                                                                                     |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Responsible lecturer:   | Prof. Dr. rer. nat. Stefan Heiss                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Lecturers:              | Prof. Dr. rer. nat. Stefan Heiss                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Relation to curriculum: | Compulsory course                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Teaching type / hours:  | Lectures / 3 hours per week, Exercises / 1 hour per week                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                    |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Prerequisites:          | Knowledge of mathematics from a Bachelor of Science program.                                                                                                                                                                                                                                                                                                                                                                                                              |
| Goals:                  | The students acquire solid knowledge about fundamental definitions and theorems from the fields of probability theory and statistics. Upon completion of the course students shall be able to perform statistical parameter estimations and hypothesis testing of samples and to transfer these techniques e. g. to applications in the field of quality control.                                                                                                         |
| Contents:               | <ul style="list-style-type: none"> <li>- Basics of probability theory (sample space, event, probability, conditional probability, random variable, expectation, variance)</li> <li>- Special distributions, central limit theorem</li> <li>- Sampling, parameter estimation, hypothesis testing</li> <li>- Regression and analysis of variance</li> <li>- Goodness of fit and nonparametric testing</li> <li>- Quality control, product and system reliability</li> </ul> |
| Examination:            | Written examination.<br>The course grade equals the grade of the written examination.                                                                                                                                                                                                                                                                                                                                                                                     |
| Teaching media:         | PowerPoint presentations, blackboard, handouts, exercises                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Literature:             | DeGroot, M. H.; Schervish, M. J.: Probability and Statistics. Pearson, 2010.<br>Gubner, J. A.: Probability and Random Processes for Electrical and Computer Engineers. Cambridge University Press, 2006.<br>Ross, S. M.: Introduction to Probability and Statistics for Engineers and Scientists. Academic Press, 2009.                                                                                                                                                   |

## Projekt- und Qualitätsmanagement (PQM / 6637)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| Modulbezeichnung:               | <b>Projekt- und Qualitätsmanagement</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Kurzzeichen / Fachnummer:       | PQM / 6637 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Studiengang:                    | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Semester:                       | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Angebotshäufigkeit:             | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Modulverantwortliche(r):        | N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Dozent(in):                     | N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Sprache:                        | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Zuordnung z. Curriculum:        | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Lehrform / SWS:                 | Vorlesung / 2 SWS<br>Übung / 2 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arbeitsaufwand:                 | 180 h = 65 h Präsenz- und 85 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Kreditpunkte:                   | 4 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Voraussetzungen:                | Formal requirements: /<br>Content requirements: /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Lernziele,<br>Kompetenzen:      | Die Studierenden kennen die wesentlichen Prozessabläufe und Methoden zur Abwicklung, Kalkulation und Finanzierung von Entwicklungsprojekten und können deren Instrumentarien anwenden. Sie kennen die Aufgaben des Qualitätsmanagements sowie den Aufbau von QM-Systemen gemäß DIN ISO 9000 ff. und können deren Werkzeuge anwenden. Die Studierenden haben Fach- und Methodenkompetenz in der Planung, Steuerung und Überwachung von Entwicklungsprojekten, bzgl. des Aufbaus von QM-Systemen und der Anwendung der QM-Werkzeuge sowie der Kalkulation und Finanzierung von Entwicklungsprojekten. Sie kennen Methoden der Problemlösung im Team und vertiefen Ihre Diskussions- und Argumentationsfähigkeit.                                                                                             |
| Inhalt:                         | <p>1. Management von Entwicklungsprojekten</p> <p>Definition, Ziele, Unterschiede Entwicklungs-/Anlagenbauprojekte; Projektphasen; Von der Idee zum Projekt: Aufgaben und Werkzeuge des Produktmanagements; Von den Kundenwünschen zur Abnahme: Aufgaben u. Werkzeuge der Planung, Steuerung u. Überwachung</p> <p>2. Qualitätsmanagement</p> <p>Definitionen, Ziele, Grundsätze der DIN ISO 9000 ff.; Methoden und Werkzeuge für das QM; Six-Sigma-Methode; rechtliche Rahmenbedingungen; Übungen mit eigenständigen Erarbeitungen zur Unterstützung der Ideenfindung, zur Ermittlung von Kundenwünschen, zur Erstellung eines Businessplans, zur Führung eines Lasten-/Pflichtenhefts, zu Kick-off-meetings, zum Projektstrukturplan, zur Nutzwertanalyse, zum Ursache-Wirkungs-Diagramm, FMEA, QFD.</p> |
| Studien-<br>Prüfungsleistungen: | Präsentation mit schriftlicher Zusammenfassung.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Medienformen:        | Tafel, Folien/Beamer                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Literatur:           | Vdf (2010): Projektmanagement.<br>Stein, F. (2004): Projektmanagement für die Projektentwicklung. Expert.<br>Linß, G. (2005): Qualitätsmanagement für Ingenieure. Hanser.<br>Geiger, W. (2005): Handbuch Qualität, Vieweg.                                                                                                                                                                                                                                         |
| Text für Transcript: | <b>Project and Quality Management</b><br>Management of development projects: phases, from the idea to the project: tasks and tools of product management; from customer requirements to project acceptance: tasks and tools of planning, control and supervision.<br>Economic basics, Business processes, Costing and Financing, Quality management: QM systems; DIN ISO 9000; process analysis and control; QM methods and tools (FMEA, QFD, scoring, Six-Sigma). |

## Project Work (PIT / 5909)

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|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Project Work</b>                                                                                                                                                                                                                                                                                                                                    |
| Abbreviation / number:  | PIT / 5909 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                      |
| Degree program:         | Information Technology (M. Sc.) according to the examination regulations of 4 July 2018                                                                                                                                                                                                                                                                |
| Semester:               | Full-time study: third semester; part-time study: fifth semester                                                                                                                                                                                                                                                                                       |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                            |
| Responsible lecturer:   | A project supervisor is assigned to each student group based on one topic. A group consists of 2 or 3 students.                                                                                                                                                                                                                                        |
| Lecturers:              | Depends on topic. It must be a professor responsible for at least one course in Information Technology (Master)                                                                                                                                                                                                                                        |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                |
| Relation to curriculum: | Compulsory course                                                                                                                                                                                                                                                                                                                                      |
| Teaching type:          | Students have access to and the support of a project supervisor, who, through periodic meetings and discussions, guides the students through the project.                                                                                                                                                                                              |
| Students' workload      | 540 hours                                                                                                                                                                                                                                                                                                                                              |
| ECTS credits:           | 18                                                                                                                                                                                                                                                                                                                                                     |
| Prerequisites:          | The prerequisites are dependent upon the project theme chosen.                                                                                                                                                                                                                                                                                         |
| Goals:                  | Students broaden their learning experiences by applying, synthesizing and reflecting upon information and materials received in the lectures. Designed as a team work for two or three students, individuals need to meet respective requirements and rules.                                                                                           |
| Contents:               | Possible topics are offered from the area of industrial information technology. The students need to organize the project work, check state-of-the-art solutions for the given problem, suggest a proposal, investigate the proposal and provide the results.                                                                                          |
| Examination:            | Each student has to produce a project report of approx. 30 pages and hand it in to the project supervisor. Finally, each participant has to present her/his contributions to the project results. Presentation time for one student is approx. 15 min.<br><br>The supervisor is allowed to ask questions in order to evaluate and assess the students. |
| Teaching media:         | Students are provided with the materials required to carry out the project.                                                                                                                                                                                                                                                                            |
| Literature:             | A literature survey needs to be done by the student.                                                                                                                                                                                                                                                                                                   |

## Regelung technischer Systeme (RTS / 5627)

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| Modulbezeichnung:            | <b>Regelung technischer Systeme</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Kurzzeichen / Fachnummer:    | RTS / 5627 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Studiengang:                 | Elektrotechnik (M. Sc.)<br>Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Angebotshäufigkeit           | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. T. Schulte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Dozent(in):                  | Prof. Dr.-Ing. T. Schulte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Übung / 1 SWS<br>Praktikum / 1 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Regelungstechnik: Grundlegende Methoden linearer und nichtlinearer Regelungen sowohl zeitkontinuierliche als auch zeitdiskret., Digitale Messtechnik, Elektro- und Maschinendynamik, Echtzeitsysteme und Matlab/Simulink-Kenntnisse                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lernziele, Kompetenzen:      | Das Fach hat zum Ziel, die Studierenden mit weiterführenden Methoden der Regelungstechnik, insbesondere für die Bereiche Fahrzeug-, Automatisierungs- und Energietechnik sowie allgemein Mechatronik, vertraut zu machen.<br>Die Studierenden werden in Lage versetzt, die Methoden auf Problemstellungen aus dem Berufsalltag von Ingenieurinnen und Ingenieuren anzuwenden. Sie verstehen die theoretischen Hintergründe und können die Methoden auf neue Problemstellungen adaptieren.                                                                                                                                                                              |
| Inhalt:                      | Es werden drei Themenbereiche in der Theorie und mit Anwendungsbeispielen aus der Automatisierungs-, Energie- und Fahrzeugtechnik behandelt:<br>1. System- und Parameteridentifikation sowie Zustandsschätzung bei rauschbehafteten Prozessen: Stochastische Prozesse, Zeit- und Frequenzbereichsverfahren, IV4-Verfahren und Kalman-Filter.<br>2. Nichtlineare Regelungen: Verfahren der Harmonischen Balance; der Entwurf schaltender Regler in der Phasenebene, wie z.B. Sliding-Mode-Regelungen für moderne Stellglieder, flachheitsbasierter Entwurf.<br>3. Simulation: Grundlegende Verfahren, Stabilität, steife Systeme, Nichtlinearitäten, Mittelwertmodelle. |
| Studien- Prüfungsleistungen: | Klausur, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Medienformen:                | Tafel, Folien/Beamer, Skript.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Literatur:                   | Isermann, R.: Mechatronische Systeme - Grundlagen. Springer 1999.<br>Gipser, M.: Systemdynamik und Simulation. Teubner, 1999<br>Föllinger, O: Nichtlineare Regelungen (Bd.1 und 2), Oldenbourg Verlag.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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|                      | 2001.<br>Unbehauen, H.: Regelungstechnik. Bd. 1-3. Vieweg Verlag<br>Isermann, R.: Identifikation dynamischer Systeme: Grundlegende Methoden. 2. Auflage, Springer, 1992.                                                                                                                                                                                       |
| Text für Transcript: | Control of Technical Systems<br>Goal: Control design of technical systems.<br>Contents: Design of controlled technical systems with focus on modelling and simulation, advanced nonlinear control methods based on the describing function technique and sliding-mode-control; estimation of parameter and state variables of noise-induced technical systems. |

## Regenerative Energien (REE / 5631)

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| Modulbezeichnung:           | <b>Regenerative Energien</b>                                                                                                                                                                                                                                                                                                                                                                  |                   |
| Kurzzeichen / Fachnummer:   | REE / 5631                                                                                                                                                                                                                                                                                                                                                                                    | Stand: 15.07.2019 |
| Studiengang:                | Elektrotechnik (M.Sc.)<br>Mechatronische Systeme (M.Sc.)                                                                                                                                                                                                                                                                                                                                      |                   |
| Semester:                   | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                   |                   |
| Angebotshäufigkeit:         | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                |                   |
| Modulverantwortliche(r):    | Prof. Dr. rer. nat. Johannes Üpping                                                                                                                                                                                                                                                                                                                                                           |                   |
| Dozent(in):                 | Prof. Dr. rer. nat. Johannes Üpping                                                                                                                                                                                                                                                                                                                                                           |                   |
| Sprache:                    | deutsch                                                                                                                                                                                                                                                                                                                                                                                       |                   |
| Zuordnung z. Curriculum:    | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                               |                   |
| Lehrform / SWS:             | Vorlesung / 2 SWS<br>Übung / 2 SWS<br>Praktikum / 0 SWS                                                                                                                                                                                                                                                                                                                                       |                   |
| Arbeitsaufwand:             | 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                           |                   |
| Kreditpunkte:               | 5 CR / 150 h                                                                                                                                                                                                                                                                                                                                                                                  |                   |
| Voraussetzungen:            | Formal: /<br>Inhaltlich: Grundkenntnisse in Mathematik und Elektrotechnik entsprechend der Zulassungsvoraussetzungen für den jeweiligen Studiengang.                                                                                                                                                                                                                                          |                   |
| Lernziele, Kompetenzen:     | Die Studierenden kennen als Fachkompetenz unterschiedliche erneuerbare Energietechniken. Sie haben die Methodenkompetenz, mittels Energie-Angebot und -nachfrage passende Lösungen zu erarbeiten. Sie haben die Befähigung, Limitierungen und Möglichkeiten der Energietechnologien in den wissenschaftlichen Kontext einzuordnen.                                                            |                   |
| Inhalt:                     | Erneuerbares globales und lokales Energieangebot; Volatilität; Sonnenspektrum; Photovoltaiksysteme; Halbleiter Bändermodell; PN Übergang einer Solarzelle; Solarzelltypen; Wirkungsgrade; Windenergiesysteme; Windverteilung; Energiedichte Wind; Aerodynamiküberblick; Laufzahl einer Windanlage; Windkraftwerkstypen; Wirkungsgrade; Wasserkraftpotential; Turbinentypen; Wasserkraftwerke; |                   |
| Studien-Prüfungsleistungen: | Mündliche Prüfung oder Klausur, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                        |                   |
| Medienformen:               | Tafel, Beamer, Skript.                                                                                                                                                                                                                                                                                                                                                                        |                   |
| Literatur:                  | Wesselak, V. / Schabbach T./ Link, T./ Fischer, J.: Regenerative Energietechnik. Springer Vieweg.                                                                                                                                                                                                                                                                                             |                   |
| Text für Transcript:        | <b>Renewable Energies</b><br>Objectives: Students have knowledge about different renewable energies like photovoltaic systems, wind turbines and waterpower. They are able to choose a suitable technology for a given energy problem.<br>Contents: Energy demand and energy needs, photovoltaics including PN-junction, PV cell types, efficiency of PV cells, wind energy distribution,     |                   |

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|  | types of wind turbines, efficiency of wind power systems, water power plants |
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**Research Project (RES / 5925)**

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|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Research Project</b>                                                                                                                                                                                                                                                                                                       |
| Abbreviation / number:  | RES / 5925 Version: 15.07.2019                                                                                                                                                                                                                                                                                                |
| Degree program:         | Information Technology (M. Sc.) according to the examination regulations of 2019                                                                                                                                                                                                                                              |
| Semester:               | Full-time study: third semester; part-time study: fifth and sixth semester                                                                                                                                                                                                                                                    |
| Frequency of the offer: | No restriction                                                                                                                                                                                                                                                                                                                |
| Responsible lecturer:   | The examiner                                                                                                                                                                                                                                                                                                                  |
| Lecturers:              | ---                                                                                                                                                                                                                                                                                                                           |
| Language:               | English                                                                                                                                                                                                                                                                                                                       |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                            |
| Teaching type / hours:  | Independent processing of a research-oriented task                                                                                                                                                                                                                                                                            |
| Students' workload:     | 4 months                                                                                                                                                                                                                                                                                                                      |
| ECTS credits:           | 30 CR                                                                                                                                                                                                                                                                                                                         |
| Prerequisites:          | Technical and methodical knowledge from the subjects of the preceding semesters of the Master's program                                                                                                                                                                                                                       |
| Goals:                  | The students get acquainted with the procedural steps in the processing of research projects, from the preparation of the application to the final documentation. For this they are involved in the processing of subtasks of current research projects. The acquired competences prepare for the subsequent Master's Thesis. |
| Contents:               | The technical content depends on the specific research-oriented task.<br>Variant 1: The students work on a subtask from a larger research project alone or in a team of two.<br>Variant 2: The students work on several subtasks from different research projects alone or in a team of two.                                  |
| Examination:            | Composition with Colloquium, graded,<br>The grade corresponds to the grade for the course.                                                                                                                                                                                                                                    |
| Teaching media:         | ---                                                                                                                                                                                                                                                                                                                           |
| Literature:             | Depends on the specific project                                                                                                                                                                                                                                                                                               |

## Robotik (ROB / 6639)

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Robotik</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Kurzzeichen / Fachnummer:    | ROB / 6639 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Studiengang:                 | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Modulverantwortliche(r):     | Prof.'in Dr. Petra Meier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Dozent(in):                  | Prof.'in Dr. Petra Meier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Lehrform / SWS:              | Vorlesung / 2 SWS<br>Übung / 1 SWS<br>Praktikum / 1 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Mathematik: lineare Algebra, Differential- und Integralrechnung<br>Technische Mechanik: Statik, Festigkeitslehre, Dynamik                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Lernziele, Kompetenzen:      | Die Studierenden können die für die Ansteuerung eines Roboterarmes nötigen Gleichungen für die Vorwärts- und Rückwärtskinematik und -dynamik anwenden. Sie können eine Bahnplanung für einen Roboterarm vornehmen. Sie können die Regelung für ein Robotersystem mit mehreren Aktoren und Sensoren selbst programmieren. Den Studierenden können einen Roboter auswählen, aufbauen und betreiben.                                                                                                                                                                                                                                                                                                                                           |
| Inhalt:                      | In der Vorlesung wird die direkte und inverse Kinematik und Dynamik von Roboterarmen vermittelt. Beginnend mit der Rotationsmatrix werden homogene Koordinaten eingeführt und die direkte Kinematik mit Hilfe der Denavit-Hartenberg-Transformation beschrieben. Zwei Methoden zur Durchführung der inversen Kinematik werden vorgestellt. Zur Berechnung der Dynamik des Roboterarmes werden Lagrange-Euler-, Newton-Euler- und der generalisierte d'Alembert-Ansatz eingeführt. Abschließend werden die theoretischen Grundlagen der Trajektorienplanung vorgestellt. Parallel dazu werden im Praktikum mit Hilfe von Lego Mindstorms mobile Roboter aufgebaut, der Umgang mit Sensoren und Aktoren geübt und eine Regelung programmiert. |
| Studien- Prüfungsleistungen: | Ausarbeitung.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Medienformen:                | Tafel, Folien/Beamer, Skript, Ilias.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Literatur:                   | Fu, Gonzalez, Lee: Robotics - Control, Sensing, Vision, and Intelligence<br>Bräunl - Embedded Robotics - Springer Verlag                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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|                      | <p>Husty, Karger, Sachs, Steinhilper - Kinematik und Robotik – Springer Verlag<br/> Nehmzow – Mobile Robotik – Springer Verlag<br/> Pfeiffer, Reithmeier – Roboterdynamik – Teubner Studienbücher<br/> Altenburg, Altenburg – Mobile Roboter – Hanser Verlag<br/> Weber – Industrieroboter – Hanser Verlag<br/> Bögelsack, Kallenbach, Linnemann – Roboter in der Gerätetechnik – Hüthig Verlag<br/> Paul - Robot Manipulators: Mathematics, Programming and Control - MIT Press<br/> Wolovich - Robotics: Basic Analysis and Design - Saunders College Publishing/Harco<br/> Woernle – Mehrkörpersysteme – Springer Verlag</p> |
| Text für Transcript: | <p><b>Robotics</b><br/> Overview of design and operation of robotics. Starting from mechanics, kinematics, dynamics, control and programming, the most important components are introduced and some examples of stationary and mobile robots are shown.</p>                                                                                                                                                                                                                                                                                                                                                                     |

## Scientific Methods (SCM / 5629)

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|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Scientific Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Abbreviation / number:  | SCM / 5629 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Degree program:         | Elektrotechnik (M. Sc.) according to the examination regulations of 6 March 2018                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Semester:               | Third semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Responsible lecturer:   | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Lecturers:              | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Relation to curriculum: | Compulsory elective course                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Teaching type / hours:  | Lecture / 2 hours per week, Lab / 3 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Students' workload      | 90 hours = 30 hours confrontation time (lectures, exercises) plus 60 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                            |
| ECTS credits:           | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Prerequisites:          | none                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Goals:                  | Students acquire basic knowledge about scientific writing and presenting. They understand typical structures of scientific papers and typical presentation styles. Good and bad examples of written scientific English are discussed.                                                                                                                                                                                                                                                                  |
| Contents:               | <ol style="list-style-type: none"> <li>1. Motivation</li> <li>2. The principles behind good and bad presentation styles               <ol style="list-style-type: none"> <li>2.1 Content</li> <li>2.2 Structure</li> <li>2.3 Design and layout</li> <li>2.4 The state of the mind</li> </ol> </li> <li>3. Hints for good presentations and slides</li> <li>4. Hints for writing scientific papers</li> <li>5. Hands-on training: A paper and a presentation on a computer<br/>science topic</li> </ol> |
| Examination:            | Project work including a written scientific paper and a presentation.<br>(The grade is not based on the content but on the writing and presentation skills.)                                                                                                                                                                                                                                                                                                                                           |
| Teaching media:         | Projector, charts, blackboard, books                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Literature:             | Reynolds G.: Presentation Zen. New Riders, 2008.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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|  | <p>Strunk, W.; White, E. B.: The Elements of Style. Allyn &amp; Bacon, 2000.</p> <p>Williams, J. M. W.: Style. Towards Clarity and Grace. Chicago University Press, 1990.</p> <p>Zinsser, W.: On Writing Well. Harper-Collins, 2006.</p> |
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## Scientific Methods and Writing (SMW / 5911)

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| Course name:            | <b>Scientific Methods and Writing</b>                                                                                                                                                                                                                                                                                                                                                                                                          |
| Abbreviation / number:  | SMW / 5911 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                              |
| Degree program:         | Elektrotechnik (M.Sc.)<br>Information Technology (M. Sc.)<br>Mechatronische Systeme (M.Sc.)                                                                                                                                                                                                                                                                                                                                                    |
| Semester:               | Elektrotechnik and Mechatronische Systeme (M.Sc.) according to the examination regulations of 2019: First semester<br>Information Technology (M. Sc.) according to the examination regulations of 2019: Full-time study: first semester; part-time study: first or third semester<br>Information Technology (M. Sc.) according to the examination regulations of 4 July 2018: Full-time study: third semester; part-time study: fifth semester |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Responsible lecturer:   | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                          |
| Lecturers:              | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                          |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Teaching type / hours:  | Lecture / 2 hours per week, Exercise / 2 hours per week                                                                                                                                                                                                                                                                                                                                                                                        |
| Students' workload      | 90 hours = 30 hours confrontation time (lectures, exercises) plus 60 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                    |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Prerequisites:          | Formal requirements: none<br>Content requirements: none                                                                                                                                                                                                                                                                                                                                                                                        |
| Goals:                  | Students acquire basic knowledge about scientific writing and presenting. They understand typical structures of scientific papers and typical presentation styles. In the practical part of the course, students gain hands-on experience in drafting, organizing and revising scientific texts. The course is targeted at non-native English speakers with intermediate language abilities.                                                   |
| Contents:               | The course provides an introduction to and application of key principles of effective and efficient scientific writing. It provides key techniques, guidelines and suggestions to improve scientific writing skills. This includes a basic understanding of the writing strategy (research, planning, summarizing), the organization of the document (structure, argumentation) and the writing                                                |

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|                 | process (avoidance of plagiarism, proper referencing, proof-reading). Good and bad examples of written scientific English are discussed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Examination:    | Project work including a written scientific paper and a presentation.<br>(The grade is not based on the content but on the writing and presentation skills.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Teaching media: | Projector, charts, blackboard, books                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Literature:     | <p>Turabian, K. L. (2013). A Manual for Writers of Research Papers, Theses, and Dissertations. The University of Chicago Press, Chicago, IL, USA.</p> <p>Sword, H. (2012). Stylish Academic Writing. Harvard University Press, Cambridge, MA, USA.</p> <p>Murray, R. (2005). Writing for Academic Journals. Open University Press, Maidenhead, Berkshire, UK.</p> <p>Strunk, W., White, E. B. (2000). The Elements of Style. Allyn &amp; Bacon, Boston, MA, USA.</p> <p>Rocco, T. S., Hatcher, T. G., Creswell, J. W. (2011). The Handbook of Scholarly Writing and Publishing. John Wiley &amp; Sons, Hoboken, NJ, USA.</p> <p>Schimmel J. (2012). Writing Science: How to Write Papers that Get Cited and Proposals that Get Funded. Oxford University Press, Oxford, UK.</p> <p>Heard, S. (2016). The Scientist's Guide to Writing: How to Write More Easily and Effectively Throughout Your Scientific Career. Princeton University Press, Princeton, NJ, USA.</p> <p>Derntl, M. (2014). Basics of Research Paper Writing and Publishing. In: International Journal of Technology Enhanced Learning, Vol. 6, No. 2, pp. 105-123.</p> |

## Scientific Working (SCW / 5620)

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| Course name:            | <b>Scientific Working</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Abbreviation / number:  | SCW / 5620 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Degree program:         | Mechatronische Systeme (M. Sc.) according to the examination regulations of 16 April 2018                                                                                                                                                                                                                                                                                                                                                                                                      |
| Semester:               | 3. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Frequency of the offer: | Wintersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Responsible lecturer:   | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Lecturers:              | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Language:               | englisch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Relation to curriculum: | Wahlpflichtfach: nichttechnisch                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Teaching type / hours:  | Vorlesung / 2 SWS<br>Übung / 0 SWS<br>Praktikum / 3 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Students' workload      | 180 h = 60 h Präsenz- und 120 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ECTS credits:           | 6 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Prerequisites:          | Grundlagen des Projektmanagements                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Goals:                  | Students acquire basic knowledge about scientific writing and presenting. They understand typical structures of scientific papers and typical presentation styles. Good and bad examples for written, scientific English are discussed.                                                                                                                                                                                                                                                        |
| Contents:               | <ol style="list-style-type: none"> <li>1 Motivation</li> <li>2 The Principles behind good and bad presentation styles               <ol style="list-style-type: none"> <li>2.1 Content</li> <li>2.2 Structure</li> <li>2.3 Design and Layout</li> <li>2.4 The state of the mind</li> </ol> </li> <li>3 Hints for good presentations and slides</li> <li>4 Hints for writing scientific papers</li> <li>5 Hands-on training: A paper and a presentation on a computer science topic.</li> </ol> |
| Examination:            | Präsentation mit schriftlicher Zusammenfassung, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                         |
| Teaching media:         | Projector, charts, blackboard, books                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Literature:             | Reynolds, G.: Presentation zen. New Riders, 2008.<br>Williams, J. M. W.: STYLE – Towards Clarity and Grace. The University of Chicago Press, 1990.<br>Zinsser, W.: On Writing Well. HarperCollins, 2006.<br>Strunk, W. Jr., White, E.B.: The Elements of Style. Allyn & Bacon, 2000.                                                                                                                                                                                                           |

## Seminar on Industrial Information Technologies (Sem / 5910)

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| Course name:            | <b>Seminar on Industrial Information Technologies</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Abbreviation / number:  | SEM / 5910 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Degree program:         | Information Technology (M. Sc.) according to the examination regulations of 4 July 2018                                                                                                                                                                                                                                                                                                                                                                                                              |
| Semester:               | Full-time study: third semester; part-time study: fifth semester                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Frequency of the offer: | Winter term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Responsible lecturer:   | Prof. Dr.-Ing. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Lecturers:              | Prof. Dr.-Ing. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Relation to curriculum: | Compulsory course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Teaching type / hours:  | Exercise / 1 hour per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Students' workload      | 90 hours = 15 hours confrontation time (exercise) plus 75 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                     |
| ECTS credits:           | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Prerequisites:          | none                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Goals:                  | Students can approach a given topic in a scientific way. This includes (i) literature research, (ii) the creation of a state-of-the-art overview, and (iii) the compilation into a paper and a presentation.                                                                                                                                                                                                                                                                                         |
| Contents:               | <ol style="list-style-type: none"> <li>1. Introduction               <ol style="list-style-type: none"> <li>1.1 What is science and what not?</li> <li>1.2 Engineering and computer science as special fields of science</li> </ol> </li> <li>2. Each student chooses a topic and generates a state-of-the-art overview. This is done in form of a scientific paper. This work overlaps with the course "Scientific Methods and Writing".</li> <li>3. The work is presented in a seminar.</li> </ol> |
| Examination:            | Project work including a written scientific paper and a presentation.<br>(The grade is only based on the content, not on the writing and presentation skills.)                                                                                                                                                                                                                                                                                                                                       |
| Teaching media:         | Projector, charts, blackboard, books                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Literature:             | <p>Bacon, F.: Novum Organum. 1620.</p> <p>Popper, K.: The Logic of Scientific Discovery. 1934.</p> <p>Taleb, N. N.: The Black Swan: The Impact of the Highly Improbable. Penguin, 2008.</p>                                                                                                                                                                                                                                                                                                          |

## Servosystemtechnik (SST / 5621)

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| Modulbezeichnung:            | <b>Servosystemtechnik</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Kurzzeichen / Fachnummer:    | SST / 5621 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Studiengang:                 | Elektrotechnik (M. Sc.), Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Semester:                    | 2. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. Holger Borcharding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Dozent(in):                  | Prof. Dr.-Ing. Holger Borcharding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Lehrform / SWS:              | Vorlesung / 3 SWS<br>Praktikum / 1 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Kreditpunkte:                | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Voraussetzungen:             | Formal: /<br>Inhaltlich: Grundgebiete der Elektrotechnik, Elektronik, Regelungstechnik, Elektrische Maschinen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Lernziele, Kompetenzen:      | Die Studierenden können die Eignung von servotechnischen Systemen für einen Prozess analysieren, das servotechnische System planen und den Prozess in Betrieb nehmen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Inhalt:                      | Klärung des Begriffes „Servotechnik“, Komponenten eines Servoantriebs, Linearantriebe, Eigenschaften von Rückführsystemen, Feldbusse für Servoanwendungen, Eigenschaften von Frequenzumrichtern für Servoanwendungen, feldorientierte Regelung von Drehstrommaschinen, Lageregelung von Servoantrieben, Aufbau der Mikroelektronik in der Servotechnik, Bremsschaltungen, Netzzurückspeisung und Zwischenkreisverbund, EMV von Servoantrieben, Steuerungstechnik von Mehrachs-Servoanwendungen: Zentrale vs. dezentrale Steuerung, Vorschubantriebe in Werkzeugmaschinen, Achsantriebe in Handhabungsgeräten und Robotern, Hauptantriebe kleiner Leistung in Bearbeitungszentren, Hilfsantriebe wie z.B. Werkstück-, Werkzeug- und Palettenwechsler, Gleichlaufantriebe, Wickelantriebe, fliegende Säge, Grundlagen der Kurvenscheibentechnik, intelligente Servoantriebe, Sicherheitstechnik. |
| Studien- Prüfungsleistungen: | Klausur oder mündliche Prüfung, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Medienformen:                | Tafel, Folien/Beamer, Skript, Vorführungen im Labor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Literatur:                   | Brosch, P. F.: Intelligente Antriebe in der Servotechnik. MI Verlag, Band 183.<br>Brosch, P. F.: Motion Control. MI Verlag, Band 240.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <p>Franz,J.: EMV-Reihe Störungssicherer Aufbau elektronischer Schaltungen. Institut für Grundlagen der Elektrotechnik und Messtechnik. Universität Hannover, 2000.</p> <p>Groß / Hamann / Wiengärtner: Elektrische Vorschubantriebe in der Automatisierungstechnik. Siemens, 2000.</p> <p>Tschätsch, H.: Werkzeugmaschinen. Hanser, 2000.</p>                                                                                                                                                                                            |
| Text für Transcript: | <p><b>Servo System Applications</b></p> <p>Goal: Be able to analyze the suitability of servo drives for a process.</p> <p>Contents: Components of a servo drive; linear drives; field-oriented control of induction machines; characteristics of frequency converters; control of servo drives; structure of microelectronics in the servo drives; EMC; central control versus decentralized control; special applications of servo drives (handling, winding, positioning, flying saw, cam disc); intelligent servo drives; safety.</p> |

## Spezielle Gebiete der Elektrotechnik (SGE / 5633)

|                              |                                                                                                                                                                                          |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Spezielle Gebiete der Elektrotechnik</b>                                                                                                                                              |
| Kurzzeichen / Fachnr.        | SGE / 5633 Version: 15.07.2019                                                                                                                                                           |
| Studiengang:                 | Elektrotechnik (M. Sc.)                                                                                                                                                                  |
| Semester:                    | 2. Semester                                                                                                                                                                              |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                           |
| Modulverantwortliche(r):     | NN                                                                                                                                                                                       |
| Dozent(in):                  | NN                                                                                                                                                                                       |
| Sprache:                     | deutsch                                                                                                                                                                                  |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                          |
| Lehrform:                    | tbd.                                                                                                                                                                                     |
| SWS:                         | 4                                                                                                                                                                                        |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                              |
| Kreditpunkte:                | 5                                                                                                                                                                                        |
| Voraussetzungen:             | tbd.                                                                                                                                                                                     |
| Lernziele, Kompetenzen:      | Dieses Wahlpflichtfach dient als Platzhalter, wenn ein Wahlpflichtfach mit Themen aus dem Gebiet der Elektrotechnik angeboten werden kann. Die Modulbeschreibung wird dann spezifiziert. |
| Inhalt:                      | Vorlesung: tbd.<br>Übung: tbd.<br>Praktikum: tbd                                                                                                                                         |
| Studien- Prüfungsleistungen: | Prüfungsform benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                      |
| Medienformen:                | tbd.                                                                                                                                                                                     |
| Literatur:                   | tbd.                                                                                                                                                                                     |
| Text für Transcript:         | <b>Special Topics in Electrical Engineering</b>                                                                                                                                          |

## Special Topics in Information Technology (STI / 5926)

|                         |                                                                                                                                                                                                           |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Special Topics in Information Technology</b>                                                                                                                                                           |
| Abbreviation / number:  | STI / 5926 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                         |
| Degree program:         | Information Technology (M.Sc.)                                                                                                                                                                            |
| Semester:               | Full-time study: second semester, part-time study: second or fourth semester                                                                                                                              |
| Frequency of the offer: | Summer term                                                                                                                                                                                               |
| Responsible lecturer:   | NN                                                                                                                                                                                                        |
| Lecturer:               | NN                                                                                                                                                                                                        |
| Language:               | English                                                                                                                                                                                                   |
| Relation to curriculum: | Compulsory optional subject                                                                                                                                                                               |
| Teaching type:          | tbd.                                                                                                                                                                                                      |
| Hours:                  | 4                                                                                                                                                                                                         |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures and exercises) plus 90 hours additional student individual work / homework time                                                                         |
| ECTS credits:           | 5                                                                                                                                                                                                         |
| Prerequisites:          | tbd.                                                                                                                                                                                                      |
| Goals:                  | This compulsory optional subject serves as a placeholder if a compulsory optional subject with topics from the field of information technology can be offered. The subject description is then specified. |
| Contents:               | Lecture: tbd.<br>Exerciseg: tbd.<br>Lab: tbd                                                                                                                                                              |
| Examination:            | Type of exam graded.<br>The exam grade is the grade for the course                                                                                                                                        |
| Teaching media:         | tbd.                                                                                                                                                                                                      |
| Literature:             | tbd.                                                                                                                                                                                                      |

## Spezielle Gebiete mechatronischer Systeme (SGM / 5634)

|                              |                                                                                                                                                                                       |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Spezielle Gebiete mechatronischer Systeme</b>                                                                                                                                      |
| Kurzzeichen / Fachnr.        | SGM / 5634 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                     |
| Studiengang:                 | Mechatronische Systeme (M. Sc.)                                                                                                                                                       |
| Semester:                    | 2. Semester                                                                                                                                                                           |
| Angebotshäufigkeit:          | Sommersemester                                                                                                                                                                        |
| Modulverantwortliche(r):     | NN                                                                                                                                                                                    |
| Dozent(in):                  | NN                                                                                                                                                                                    |
| Sprache:                     | deutsch                                                                                                                                                                               |
| Zuordnung z. Curriculum:     | Wahlpflichtfach                                                                                                                                                                       |
| Lehrform:                    | tbd.                                                                                                                                                                                  |
| SWS:                         | 4                                                                                                                                                                                     |
| Arbeitsaufwand:              | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                           |
| Kreditpunkte:                | 5                                                                                                                                                                                     |
| Voraussetzungen:             | tbd.                                                                                                                                                                                  |
| Lernziele, Kompetenzen:      | Dieses Wahlpflichtfach dient als Platzhalter, wenn ein Wahlpflichtfach mit Themen aus dem Gebiet der Mechatronik angeboten werden kann. Die Modulbeschreibung wird dann spezifiziert. |
| Inhalt:                      | Vorlesung: tbd.<br>Übung: tbd.<br>Praktikum: tbd                                                                                                                                      |
| Studien- Prüfungsleistungen: | Prüfungsform benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                   |
| Medienformen:                | tbd.                                                                                                                                                                                  |
| Literatur:                   | tbd.                                                                                                                                                                                  |
| Text für Transcript:         | <b>Special Topics in Mechatronic Systems</b>                                                                                                                                          |

## Theorie elektromagnetischer Felder (TEF / 5624)

|                              |                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:            | <b>Theorie elektromagnetischer Felder</b>                                                                                                                                                                                                                                                                                                             |
| Kurzzeichen / Fachnummer:    | TEF / 5624 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                     |
| Studiengang:                 | Elektrotechnik (M. Sc.)<br>Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                            |
| Semester:                    | 1. Semester                                                                                                                                                                                                                                                                                                                                           |
| Angebotshäufigkeit:          | Wintersemester                                                                                                                                                                                                                                                                                                                                        |
| Modulverantwortliche(r):     | Prof. Dr.-Ing. Oliver Stübbe                                                                                                                                                                                                                                                                                                                          |
| Dozent(in):                  | Prof. Dr.-Ing. Oliver Stübbe                                                                                                                                                                                                                                                                                                                          |
| Sprache:                     | deutsch                                                                                                                                                                                                                                                                                                                                               |
| Zuordnung z. Curriculum:     | Elektrotechnik (M. Sc.): Pflichtfach<br>Mechatronische Systeme (M. Sc.): Wahlpflichtfach                                                                                                                                                                                                                                                              |
| Lehrform / SWS:              | Vorlesung / 3 SWS<br>Übung / 1 SWS                                                                                                                                                                                                                                                                                                                    |
| Arbeitsaufwand:              | 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                   |
| Kreditpunkte:                | 5 CR / 150 h                                                                                                                                                                                                                                                                                                                                          |
| Voraussetzungen:             | Formal:<br>Inhaltlich: Feldtheoretische Grundlagen der Elektrotechnik, Mathematik.                                                                                                                                                                                                                                                                    |
| Lernziele, Kompetenzen:      | Die Studierenden kennen als Fachkompetenz die Maxwellschen Gleichungen in Integral- und Differentialform. Sie haben die Methodenkompetenz, mittels dieser Gleichungen feldtheoretische Fragestellungen eigenständig zu analysieren und selbständig auf neue Problemstellungen anzuwenden. Sie können die erzielten Ergebnisse selbständig evaluieren. |
| Inhalt:                      | Maxwellsche Gleichungen in differentieller und integraler Form, Materialgesetze, Klassifizierung von Feldproblemen, Maxwellsche Gleichungen bei stationären, quasistationären und zeitveränderlichen elektromagnetischen Feldern, Lösungsverfahren für elektromagnetische Feldprobleme, Ausbreitung von elektromagnetischen Wellen.                   |
| Studien- Prüfungsleistungen: | Mündliche Prüfung oder Klausur, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                |
| Medienformen:                | Tafel, Beamer, Skript.                                                                                                                                                                                                                                                                                                                                |
| Literatur:                   | Henke, H.: Elektromagnetische Felder. Springer, 2007.<br>Küpfmüller, K.: Theoretische Elektrotechnik. Springer, 2008.<br>Lehner, G.: Elektromagnetische Feldtheorie für Ingenieure und Physiker. Springer, 2010.                                                                                                                                      |
| Text für Transcript:         | <b>Electromagnetic Field Theory</b><br>Objectives: Being able to understand the principles of Maxwell's equations and their applications.<br>Contents: Maxwell's equations, boundary conditions, analysis of static and time-varying electromagnetic fields, electromagnetic waves.                                                                   |

## Thermodynamik mechatronischer Geräte (TMG / 6620)

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modulbezeichnung:               | <b>Thermodynamik mechatronischer Geräte</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Kurzzeichen / Fachnummer:       | TMG / 6620 <span style="float: right;">Stand: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Studiengang:                    | Mechatronische Systeme (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Semester:                       | 1. Semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Angebotshäufigkeit:             | Wintersemester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Modulverantwortliche(r):        | N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Dozent(in):                     | N.N.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Sprache:                        | deutsch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Zuordnung z. Curriculum:        | Wahlpflichtfach                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Lehrform / SWS:                 | Vorlesung / 2 SWS<br>Übung / 1 SWS<br>Praktikum / 1 SWS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Arbeitsaufwand:                 | 150 h = 60 h Präsenz- und 90 h Eigenstudium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Kreditpunkte:                   | 5 CR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Voraussetzungen:                | Formal: /<br>Inhaltlich: Grundgebiete der Elektrotechnik                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Lernziele,<br>Kompetenzen:      | Die Studierenden erwerben Kompetenzen, thermodynamische Probleme zu identifizieren und bereits im Entwurfsstadium geeignete Maßnahmen zur Problemvermeidung zu ergreifen.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Inhalt:                         | In diesem Modul werden die möglichen Ursachen für eine Wärmefreisetzung und die Bedeutung von Übertemperaturen auf mechatronische Bauteile bei stationären und instationären Systemen behandelt. Die Möglichkeiten zum passiven Transport, speziell zur Abfuhr von Wärme durch Leitung, Konvektion und Strahlung werden vorgestellt. Ferner werden aktive Methoden zur Kühlung wie z.B. thermoelektrische Kühler oder sog. Heat-Pipes behandelt. Beispiele: Temperaturbedingte Störungen von IC's, Wärmeleitung in Platinen, Konvektion an Kühlkörpern, Energiebilanzierung einer Heat-Pipe. |
| Studien-<br>Prüfungsleistungen: | Klausur oder mündliche Prüfung, benotet.<br>Die Note entspricht der Note für das Fach.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Medienformen:                   | Tafel, Folien/Beamer, schriftliche Unterrichtsunterlagen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Literatur:                      | von Böckh, P.: Wärmeübertragung. Springer, 2004.<br>Windisch, H.: Thermodynamik. Oldenbourg, 2001.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Text für Transcript:            | <b>Thermodynamics of Mechatronic Devices</b><br>Malfunction of mechatronic devices due to thermal effects. Temperature dependent properties of semiconductors, metals and gases. Estimation of spatial temperature distributions. Steady and unsteady transport of heat. Equations of state and diffusion. Forced convection. Technical improvement of heat transfer. Heat pipes.                                                                                                                                                                                                            |

## Usability Engineering (UEN / 5916)

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|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Usability Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Abbreviation / number:  | UEN / 5916 <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Degree program:         | Information Technology (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Semester:               | Full-time study: first semester; part-time study: first or third semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Responsible lecturer:   | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Lecturers:              | Prof. Dr.-Ing. Dr. rer. soc. Dr. phil. Carsten Röcker                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Relation to curriculum: | Compulsory subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Teaching type / hours:  | Lecture / 2 hours per week, Exercises / 2 hours per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Prerequisites:          | Formal requirements: /<br>Content requirements: /                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Goals:                  | Students gain theoretical and practical knowledge of the most important user-centered design techniques and their alignment in the development process. They are able to assess the individual strengths and weaknesses of different approaches for evaluating the usability of various types of information technologies. This includes the ability to plan and execute user studies for evaluating the usability of specific information technologies. In the practical part of the course, the students acquire experience in applying the various methods and techniques to a design task.                                                                                                                                      |
| Contents:               | Today, the success of information technologies is largely influenced by its usability and user-friendly design has become an essential requirement for most systems. In this context, usability is defined as the extent to which a system can be used by a specific user to achieve a specific goal in a specific context with effectiveness, efficiency and satisfaction. In order to reach this goal, this course provides basic principles of usability engineering methods for the design and evaluation of information technologies. This includes basic concepts of human-computer interaction, user interface design strategies, software development and evaluation methods as well as practical guidelines and standards. |
| Examination:            | Composition with Colloquium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Teaching media:         | Projector, blackboard, charts, lecture notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Literature:             | Richter, M., Flückiger, M. (2014). User-Centred Engineering. Creating Products for Humans. Springer, Heidelberg.<br>Bill Albert, Tom Tullis (2013). Measuring the User Experience: Collect-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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|  | <p>ing, Analyzing, and Presenting Usability Metrics. Morgan Kaufmann. Morgan Kaufmann, Burlington, MA, USA.</p> <p>Carol M. Barnum (2010). Usability Testing Essentials: Ready, Set...Test! Morgan Kaufmann, Burlington, MA, USA.</p> <p>Philip Kortum (2016). Usability Assessment: How to Measure the Usability of Products, Services, and Systems: User's Guides to Human Factors and Ergonomics Methods. Human Factors and Ergonomics Society.</p> <p>David C. C. Evans (2017). Bottlenecks: Aligning UX Design with User Psychology. Apress, New York, NY, USA.</p> |
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## Wireless Communications (5904 / WLC)

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|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Course name:            | <b>Wireless Communications</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Abbreviation / number   | 5904 / WLC <span style="float: right;">Version: 15.07.2019</span>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Degree program:         | Elektrotechnik (M. Sc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Semester:               | Second semester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Frequency of the offer: | Summer term                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Responsible lecturer:   | Prof. Dr.-Ing. Uwe Meier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Lecturers:              | Prof. Dr.-Ing. Uwe Meier                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Language:               | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Relation to curriculum: | Compulsory optional subject                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Teaching type / hours:  | Lecture / 3 hours per week, Exercise or lab / 1 hour per week                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Students' workload:     | 150 hours = 60 hours confrontation time (lectures, exercises, and labs) plus 90 hours additional student individual work/homework time                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ECTS credits:           | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Prerequisites:          | Signals and linear systems, basics of modulation, basics of random processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Goals:                  | <p>Students acquire system-theoretical knowledge of the physical and MAC layer of modern radio systems.</p> <p>They are able to determine and to model real propagation channel characteristics. They can assess the performance limits of wireless systems including modulation and channel coding.</p> <p>They learn how to use appropriate simulation and network planning tools in order to predict the quality and the limitations of wireless radio systems.</p> <p>After completion of the course, students are able to critically analyze wireless system problems and create appropriate solutions.</p> |
| Contents:               | <p>Mobile radio channels (multipath propagation, Doppler effects, Bello functions, channel measurements and characterization, channel modeling)</p> <p>Advanced modulation methods (theoretical limitations, spread spectrum systems, multicarrier systems, ultra-wide band radio)</p> <p>Channel coding including space-time codes, MIMO (multiple input - multiple output) systems</p> <p>Further topics: Software-defined radio (SDR), cognitive radio systems, coexistence management</p>                                                                                                                    |
| Examination:            | Oral examination                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Teaching media:         | Projector / charts, blackboard, lab equipment, simulation software                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Literature:             | Script, exercise problems and lab tasks for downloading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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|  | <p>Haykin, Simon, and Michael Moher: Modern Wireless Communications. Pearson-Prentice Hall.</p> <p>Pahlavan, K., and A.H. Levesque: Wireless Information Networks. Wiley.</p> <p>Paulraj, A., R. Nabar, and D. Gore: Introduction to Space-Time Wireless Communications. Cambridge UP.</p> <p>Rappaport, T. S.: Wireless Communications, Principles and Practice. Prentice Hall.</p> |
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