



Curriculum
of the
Master's Program
Engineering Sciences
at Rosenheim Technical University of Applied Sciences
Status: January 25, 2025

Contents

| | | |
|----------|--|--------------|
| 1 | Course Overview | I |
| 2 | Overview of Available Courses | IV |
| 2.1 | Courses offered by the Faculty of Engineering Sciences | IV |
| 2.1.1 | MG group courses | IV |
| 2.1.2 | MA group courses | V |
| 2.1.3 | MV group courses | V |
| 2.1.4 | MF group courses | VII |
| 2.2 | Courses offered by other departments of the Technical University of applied Sciences | VIII |
| 2.2.1 | Courses offered by the Faculty of Informatics: Masterstudium Informatik | VIII |
| 2.2.2 | Courses offered by Bavarian Virtual University (Virtuelle Hochschule Bayern) | IX |
| 2.2.3 | Courses offered by the language center | IX |
| 2.2.4 | Elective course offered by Faculty of Management and Engineering . | X |
| 2.3 | Organisation of courses | XI |
| 2.3.1 | Summer term 2025 | XI |
| 2.3.2 | Winter term 2025/26 (Preliminary) | XII |
| 3 | Recommendations for your individual study plan | XIII |
| 4 | Remarks on Master´s project and Master thesis | XVI |
| 4.1 | Master´s project | XVI |
| 4.2 | Electronic Workflow for Master thesis | XVI |
| 4.3 | Guidelines for the preparation of final thesis at the Faculty of Engineering . . | XVI |
| 4.4 | Declaration of Originality/Eigenständigkeitserklärung | XVII |
| 5 | Important notes for SPO 2019 | XVIII |
| 6 | Important notes for SPO 2016 | XVIII |
| 7 | Remarks on Module Descriptions | XIX |
| 8 | Course Descriptions | 1 |

1 Course Overview

| Course | Course designation | SWS | ECTS Points | Page |
|-------------|---|-----|-------------|-------|
| MG01 | Advanced Engineering Mathematics | 4 | 5 | S. 1 |
| MG02 | Electrodynamics | 4 | 5 | S. 3 |
| MG04 | Statistics | 4 | 5 | S. 5 |
| MG05 | Fluid Mechanics | 4 | 5 | S. 7 |
| MG06 | Applied numerical methods | 4 | 5 | S. 9 |
| MG07 | Physical Metallurgy | 4 | 5 | S. 11 |
| MA01 | Real-Time Systems | 4 | 5 | S. 13 |
| MA02 | Integrated Circuit System Design and Test | 4 | 5 | S. 15 |
| MA03 | Mixed Signal Systems | 4 | 5 | S. 17 |
| MA04 | Selected Topics in Assembly Technology | 4 | 5 | S. 19 |
| MA05 | Model-Based Development | 4 | 5 | S. 21 |
| MA06 | Materials from Renewable Resources | 4 | 5 | S. 23 |
| MF01 | Microelectronics | 4 | 5 | S. 25 |
| MF04 | Applied Didactics | - | 5 | S. 27 |
| MF10 | Electronic Packaging and Manufacturing | 4 | 5 | S. 28 |
| MF14 | Power Electronic Circuit Design | 2 | 3 | S. 30 |
| MF20 | RF and Microwave Systems | 4 | 5 | S. 32 |
| MF22 | Kalman Filtering in Control Systems and Communications Applications | 4 | 5 | S. 34 |
| MF23 | Design of Materials | 3 | 5 | S. 36 |
| MF24 | Ceramics and other Sintering materials | 2 | 3 | S. 38 |
| MF30 | Experimental modeling and simulation | 4 | 5 | S. 39 |
| MF31 | Advanced Design for Additive Manufacturing | 4 | 5 | S. 41 |

| | | | | |
|-------------|---|---|---|-------|
| MF32 | Intellectual Property Protection | 2 | 3 | S. 42 |
| MF33 | Heat Transfer | 2 | 3 | S. 44 |
| MF36 | Trajectory Planning for Robots and Automatic Machines | 4 | 5 | S. 46 |
| MF37 | Chemistry of renewable resources | 4 | 5 | S. 48 |
| MF38 | Chemical H ₂ Conversion: Applications and industrial processes | 4 | 5 | S. 50 |
| MF39 | International Master Summer School | 4 | 5 | S. 52 |
| MF42 | Homogeneous Catalysis | 4 | 5 | S. 55 |
| MF43 | Techno-economic Analysis and Simulation | 4 | 5 | S. 57 |
| MF45 | Microscopy – methods and applications in materials science | 2 | 3 | S. 59 |
| MV01 | Advanced Control Systems | 4 | 5 | S. 61 |
| MV02 | Industrial Process Control | 4 | 5 | S. 63 |
| MV03 | Servo Drive Systems | 4 | 5 | S. 65 |
| MV04 | Automation Systems | 4 | 5 | S. 68 |
| MV05 | Reliability of Mechatronic Systems | 4 | 5 | S. 70 |
| MV07 | Advanced Digital Communications | 4 | 5 | S. 72 |
| MV08 | Digital Signal Processing and Machine Learning | 4 | 5 | S. 74 |
| MV09 | Advanced FEM | 4 | 5 | S. 76 |
| MV10 | Electromagnetic Compatibility | 4 | 5 | S. 78 |
| MV11 | Image Processing for Automated Production | 4 | 5 | S. 80 |
| MV12 | Mechanical Design | 4 | 5 | S. 82 |
| MV13 | Advanced light weight construction | 4 | 5 | S. 84 |
| MV14 | Advanced injection molding | 4 | 5 | S. 86 |
| MV15 | Selected topics of Polymer Chemistry and Materials Sciences | 4 | 5 | S. 87 |

| | | | | |
|-------------|--|----|----|-------|
| MV16 | Freeform-Surfaces | 4 | 5 | S. 89 |
| MV17 | Mechanical Transmission | 4 | 5 | S. 91 |
| MV18 | Geometric Dimensioning and Tolerancing | 4 | 5 | S. 92 |
| MP01 | Master's project | 10 | 12 | S. 94 |
| MP02 | Master Thesis | 24 | 25 | S. 96 |

2 Overview of Available Courses

Students are free which courses they choose during their studies. All courses are grouped into so called module pools. The only restriction is, that a certain number of credit points must be collected in each module pool.

2.1 Courses offered by the Faculty of Engineering Sciences

This section gives an overview of available courses offered by the faculty of engineering sciences of the Technical University of Applied Sciences Rosenheim.

- A minimum of 10 CPs must be earned from the MG group of courses.
- A minimum of 10 CPs must be earned from the MA group of courses.
- A minimum of 20 CPs must be earned from the MV group of courses.
- A minimum of 13 CPs must be earned from the MF group of elective courses

2.1.1 MG group courses

These courses consist of advanced mathematics courses and advanced natural science based courses. The focus of these courses is on theory. Every student must take 2 courses out of this module pool.

| No. | Module | SWS | ECTS | Form of Course | Examination 1) | | Supplementary regulations |
|------|---|-----|------|----------------|--|----|---------------------------|
| | | | | | Type and Duration | ZV | |
| MG01 | Advanced Mathematics <i>Angewandte Mathematik</i> | 4 | 5 | SU, Ü | schrP 60-180 min, mdlP 20-60 min, eLP 20-180 min or PStA 2-15 Wo | - | |
| MG02 | Electrodynamics <i>Elektrodynamik</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, eLP 20-180 min or PStA 2-15 Wo | - | |
| MG04 | Statistics <i>Statistik</i> | 4 | 5 | SU, Ü | schrP 60-180 min, mdlP 20-60 min, eLP 20-180 min or PStA 2-15 Wo | - | |
| MG05 | Fluid Mechanics <i>Strömungsmechanik</i> | 4 | 5 | SU, Ü | schrP 60-180 min, mdlP 20-60 min, eLP 20-180 min or PStA 2-15 Wo | - | schrP 75% PStA 25% |
| MG06 | Applied numerical methods | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, eLP 20-180 min or PStA 2-15 Wo | - | |
| MG07 | Physical Metallurgy | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, eLP 20-180 min or PStA 2-15 Wo | - | |

Figure 1: MG group courses

- 1) At least a grade of 4.0 for all examination parts is necessary to pass the examination.

2.1.2 MA group courses

These courses consist of advanced application-based courses. The focus is more on practical aspects, tools and applications. All courses are accompanied by lab courses, where you can train your practical skills. Every student must take 2 courses out of this module pool.

| No. | Module | SWS | ECTS | Form of Course | Examination 1) | | Supplementary regulations |
|------|---|-----|------|----------------|--|----|---------------------------|
| | | | | | Type and Duration | ZV | |
| MA01 | Real-Time Systems <i>Realzeitsysteme</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MA02 | Integrated Circuit System Design and Test <i>IC-Systementwurf und -test</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MA03 | Mixed Signal Systems <i>Mixed-Signal-Systeme</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MA04 | Selected Topics in Assembly Technology <i>Ausgewählte Themen der Montagetechnik</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 2) | |
| MA05 | Model based Development <i>Modellbasierter Entwurf</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 2) | |
| MA06 | Materials from Renewable Resources <i>Materialien aus erneuerbaren Quellen</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 3) | |

Figure 2: MA group courses

- 1) At least a grade of 4.0 for all examination parts is necessary to pass the examination.
- 2) Admittance to the examination is only possible, if you pass the lab course (LNmE).
- 3) Attendance of the seminar is necessary to get a grade for the module.

2.1.3 MV group courses

The courses in the MV pool are specialization specific. A “x” in the last three columns of the next table tells you, which courses you are allowed to take according to your chosen specialization. The focus is also on practical aspects, most courses have an additional lab course. Every student must take 4 courses out of this module pool.

| No. | Module | SWS | ECTS | Form of Course | Examination 1) | | Supplementary regulations | EIT | MEC | MEN PEN |
|------|---|-----|------|----------------|--|----|---------------------------|-----|-----|---------|
| | | | | | Type and Duration | ZV | | | | |
| MV01 | Advanced Control Systems <i>Regelungstechnik</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | X | |
| MV02 | Industrial Process Control <i>Industrielle Steuerungstechnik</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | X | |
| MV03 | Servo Drive Systems <i>Servoantriebssysteme</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | X | |
| MV04 | Automation Systems <i>Automatisierungssysteme</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | 2) | | X | X | |
| MV05 | Reliability of Mechatronic Systems <i>Zuverlässigkeit mechatronischer</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | X | X |
| MV07 | Advanced Digital Communication <i>Nachrichtenübertragung</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | | |
| MV08 | Digital Signal Processing and Machine Learning <i>Digitale Signalverarbeitung und maschinelles Lernen</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | X | |
| MV09 | Advanced FEM <i>FEM</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | X | X |
| MV10 | Electromagnetic Compatibility <i>Elektromagnetische Verträglichkeit</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | X | |
| MV11 | Image Processing for Automated Production <i>Bildverarbeitung in der Produktion</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | X | X | |
| MV12 | Mechanical Design <i>Mechanische Konstruktion</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | X | X |
| MV13 | Advanced Lightweight Construction <i>Leichtbau Vertiefung</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | | X |
| MV14 | Advanced Injection Molding <i>Spritzgusstechnologie</i> | 4 | 5 | SU, Ü | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | | X |
| MV15 | Selected Topics of Polymer Chemistry and Materials Sciences <i>Ausgewählte Themen der Polymerchemie und Materialwissenschaften</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | | X |
| MV16 | Free Form Surfaces <i>Freiformflächen</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | | X |
| MV17 | Mechanical Transmission <i>Getriebe Technologien</i> | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | | X |
| MV18 | Geometric Dimensioning and Tolerancing | 4 | 5 | SU, Pr | schrP 60-180 min, mdlP 20-60 min, elP 20-180 min or PStA 2-15 Wo | - | | | X | X |

Figure 3: MV group courses

- 1) At least a grade of 4.0 for all examination parts is necessary to pass the examination.
- 2) Admittance to the examination is only possible, if you pass the lab course (LNmE).

2.1.4 MF group courses

| No. | Module | SWS | ECTS | Form of Course | Examination 1) | | Supplementary regulations |
|------|---|-----|------|----------------|--|----|---------------------------|
| | | | | | Type and Duration | ZV | |
| MF01 | Microelectronics | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | schrP 40% mdIP 60% |
| MF04 | Applied Didactics | 4 | 5 | Tutorial | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF10 | Electronics Packaging and Manufacturing | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF14 | Power Electronics Circuit Design | 2 | 3 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF20 | RF and Microwave Systems | 4 | 5 | SU, Ü | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF22 | Kalman Filtering in Control Systems and Communication Applications | 4 | 5 | SU, Ü | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF23 | Design of Materials | 3 | 5 | SU, Ü | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF24 | Ceramics and other Sintering materials | 2 | 3 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF30 | Experimental Modelling and Simulation | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF31 | Advanced Design for Additive Manufacturing | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF32 | Intellectual Property Protection | 2 | 3 | SU | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF33 | Heat Transfer | 2 | 3 | SU | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF36 | Trajectory Planning for Robots and Automatic Machines | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF37 | Chemistry of renewable resources | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 2) | |
| MF38 | Chemical H ₂ conversion: Applications and industrial processes | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 2) | |
| MF39 | International Summer School (1 week part - non ING) | 2 | 2 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | - | |
| MF42 | Homogeneous Catalysis | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 2) | |
| MF43 | Techno-economic Analysis and Simulation | 4 | 5 | SU, Pr | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | 2) | |
| MF45 | Microscopy - different methods and applications in materials science | 2 | 3 | SU, Ü | schrP 60-180 min, mdIP 20-60 min, eIP 20-180 min or PStA 2-15 Wo | | |

Figure 4: MF group courses

- 1) At least a grade of 4.0 for all examination parts is necessary to pass the examination.
- 2) Admittance to the examination is only possible, if you pass the lab course (LNmE).

Please note that Technical University of Applied Sciences is under no obligation to offer an ENG Master's program elective course (MF group) when enrollment is insufficient!

A minimum number of 10 participants is required for elective courses (MF group) to take place.


The Faculty Council of the Faculty of Engineering decides on cancellation of modules due to insufficient number of participants.

For courses which are mainly based on lab class work, enrollment may be limited.

On request courses from the MV group can be taken to fulfill the MF credits requirement of 13 CPs. However this has to be explicitly approved by the ENG-Master's Program Examination Commission.

2.2 Courses offered by other departments of the Technical University of applied Sciences

Instead of choosing MF group courses from the Faculty of Engineering Sciences, you can also choose courses which are listed in the following subsections.

Important notice: In any case you also have to submit the following [registration form](#) 

2.2.1 Courses offered by the Faculty of Informatics: Masterstudium Informatik

The following courses are offered as joint modules for the Master Course Engineering Sciences and for the Masterstudium Informatik. Please note that these modules are taught in German only. Up to 10 Students could apply per email to franz.perschl@th-rosenheim.de for a course. In case of overload in applications, the general rules according §7 Abs. 5 Satz 2 Immatrikulationssatzung apply.

Winter Term:

- Computer Vision
- Embedded Linux
- Systems Engineering

Summer Term:

- Autonome mobile Systeme
- Maschinelles Lernen
- Eingebettete Echtzeitsysteme

Detailed course descriptions are found [here](#) 


Application for course “Maschinelles Lernen” will not be accepted, if the applicant has taken the course “Grundlagen maschinellen Lernens” during his Bachelor study at TH Rosenheim.

2.2.2 Courses offered by Bavarian Virtual University (Virtuelle Hochschule Bayern)

The following courses may also be granted on request for the master course in engineering sciences. Before you register, please submit the registration form as depicted in the section before.

Winter Term and Summer Term:

- Integrated Production Systems
- Leadership and Communication in Global Business
- Machine Learning for Engineers I

Here you can get additional information on [VHB courses](#) 

2.2.3 Courses offered by the language center

The following courses offered by the language center of the Faculty of Applied Natural Sciences and Humanities can be granted as MF-modules. German speaking students can choose the English courses, non-German speaking students are recommended to choose the German language courses. Accreditation is limited to a maximum of 5 Credit Points.

Winter Term and Summer Term:

- Deutsch B1.1 / German B1.1
- Deutsch B1.2 / German B1.2
- Deutsch B2.1 / German B2.1
- Deutsch B2.2 / German B2.2
- Deutsch B2 kompakt / German B2
- DaF: Kommunizieren und Präsentieren / DaF: Communication and Presentation
- Technical and Business English
- Business English

You will find additional information on courses offered by the language center by following this links:

[German language courses](#) 

[English language courses](#) 

2.2.4 Elective course offered by Faculty of Management and Engineering

The following course is offered by the Faculty of Management and Engineering. It can be granted as MF course. Winter Term and Summer Term:

- Renewable Energies

Further information can be found [here](#) 

2.3 Organisation of courses

Most of the courses mentioned in above tables are only offered once a year. In the following subsections, you can see the plan for the next two semesters.

2.3.1 Summer term 2025

| No. | Modul / Course Title | Lecturer | | | Type | Hours | CPs |
|--|--|--|-----|----|---|--------------|-----|
| MG01 | Advanced Engineering Mathematics | Prof. Dr. Schulze | | | Lect./Exerc. | 4 | 5 |
| MG05 | Fluid Mechanics | Prof. Dr. Buttlinger / Prof. Dr. Schäfle | | | Lect./Exerc. | 4 | 5 |
| MG07 | Physical Metallurgy | Prof. Dr. Schneeweis | | | Lect./Lab | 4 | 5 |
| MA01 | Real-Time Systems | Prof. Dr. Mysliwetz | | | Lect./Lab | 4 | 5 |
| MA02 | Integrated Circuit System Design and Test | Prof. Dr. Versen | | | Lect./Lab | 4 | 5 |
| MA06 | Materials from Renewable Resources | Prof. Dr. Schroeter | | | Lect./Exerc. | 4 | 5 |
| | | EIT | MEC | MK | | | |
| MV04 | Automation Systems | x | x | | Prof. Dr. Meierlohr | Lect./Lab | 4 5 |
| MV08 | Digital Signal Processing and Machine Learning | x | x | | Prof. Dr. Stiehler | Lect./Lab | 4 5 |
| MV10 | Electromagnetic Compatibility | x | x | | Prof. Dr. Seliger | Lect./Lab | 4 5 |
| MV12*** | Mechanical Design | | x | x | Prof. Dr. Ragai | Lect./Proj. | 4 5 |
| MV13 | Advanced light weight construction | | | x | Prof. Dr. Reiß | Lect./Exerc. | 4 5 |
| MV14 | Advanced Injection Molding | | | x | Prof. Dr. Würtele | Lect./Proj. | 4 5 |
| MV17 | Mechanical Transmission | | | x | Prof. Dr. Doleschel | Lect./Proj. | 4 5 |
| MV18 | Geometric Dimensioning and Tolerancing | | x | x | Prof. Dr. Lazar | Lect./Lab | 4 5 |
| MF04 | Applied Didactics | | | | offered on demand | Tutorial | 2 3 |
| MF10 | Electronics Packaging and Manufacturing | | | | Prof. Dr. Winter | Lect./Lab | 4 5 |
| MF14 | Power Electronics Circuit Design | | | | Prof. Dr. Seliger | Lect./Lab | 2 3 |
| MF20 | RF and Microwave Systems | | | | Prof. Dr. Leather | Lect./Exerc. | 4 5 |
| MF30 | Experimental Modelling and Simulation | | | | Prof. Dr. Zentgraf | Lect./Lab | 4 5 |
| MF31 | Advanced Design for Additive Manufacturing | | | | Prof. Dr. Reiß | Lect./Lab | 4 5 |
| MF32 | Intellectual Property Protection | | | | LB Wagner | Lect. | 2 3 |
| MF33 | Heat Transfer | | | | Prof. Dr. Stanzel | Lect. | 2 3 |
| MF36 | Trajectory Planning for Robots and Automatic Machines | | | | Prof. Dr. King | Lect./Lab | 4 5 |
| MF37 | Chemistry of renewable resources | | | | Prof. Dr. List / Prof. Dr. Pentlechner | Lect./Lab | 4 5 |
| MF43 | Techno-economic Analysis and Simulation | | | | Prof. Dr. Völkl | Lect./Lab | 4 5 |
| * | AW-0 0 5170.M Technical and Business English | | | | CCC | Lect. | 4 5 |
| * | AW-0 0 5160.M Business English | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5740.M Deutsch B1.1 / German B1.1 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5750.M Deutsch B1.2 / German B1.2 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5760.M Deutsch B2.1 / German B2.1 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5770.M Deutsch B2.2 / German B2.2 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5760.M Deutsch B2 kompakt / German B2 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 05710.M DaF: Kommunizieren und Präsentieren / DaF: Communication and Presentation | | | | CCC | Lect. | 4 5 |
| MP02 | Master's Project | | | | | 10 | 12 |
| VHB | Integrated Production Systems | | | | Prof. Dr. Franke, Uni Erlangen-Nürnberg | 4 | 5 |
| VHB | Leadership and Communication in Global Business | | | | Prof. Dr. Winkler, FH Kempten | 2 | 3 |
| VHB | Machine Learning for Engineers I | | | | Prof. Dr. Eskofier, Uni Erlangen-Nürnberg | 4 | 5 |
| * for German students only; will be accepted as MF module restricted to a maximum of 5 Credit Points; offer is dependent on free capacity of the language cent | | | | | | | |
| ** for non-German students only; will be accepted as MF module restricted to a maximum of 5 Credit Points | | | | | | | |
| *** block course | | | | | | | |
| Rev. Jan 23, 25 | | | | | | | |

Figure 5: Engineering Sciences Master's Program – Courses offered in summer term 2025

2.3.2 Winter term 2025/26 (Preliminary)

| No. | Modul / Course Title | Lecturer | | | Type | Hours | CPs |
|---|--|---------------------------------|-----|----|---|--------------|-----|
| MG02 | Electrodynamics | Prof. Dr. Seliger | | | Lect./Exerc. | 4 | 5 |
| MG04 | Statistics | Prof. Dr. Schmiedt | | | Lect./Exerc. | 4 | 5 |
| MG06 | Applied numerical methods | Prof. Dr. Reiß / Prof. Dr. King | | | Lect./Lab | 4 | 5 |
| MA03 | Mixed Signal Systems | Prof. Dr. Stubenrauch | | | Lect./Lab | 4 | 5 |
| MA04 | Selected topics in assembly technology | Prof. Dr. Meierlohr | | | Lect./Exerc. | 4 | 5 |
| MA05 | Model based development | Prof. Dr. Perschl | | | Lect./Lab | 4 | 5 |
| MA06 | Materials from Renewable Resources | Prof. Dr. Schroeter | | | Lect./Exerc. | 4 | 5 |
| | | EIT | MEC | MK | | | |
| MV01 | Advanced Control Systems | x | x | | Prof. Dr. King | Lect./Lab | 4 5 |
| MV02 | Industrial Process Control | x | x | | Prof. Dr. Krämer / Prof. Dr. Perschl | Lect./Lab | 4 5 |
| MV03 | Servo Drive Systems | x | x | | Prof. Dr. Hagl | Lect./Lab | 4 5 |
| MV05 | Reliability of Mechatronic Systems | | x | x | Prof. Dr. Versen | Lect./Lab | 4 5 |
| MV07 | Advanced Digital Communications | x | | | Prof. Dr. Stiehler | Lect./Lab | 4 5 |
| MV09 | Advanced FEM | | x | x | Prof. Dr. Schinagl | Lect./Exerc. | 4 5 |
| MV11 | Image Processing for automated Production | x | x | | Prof. Dr. Wagner | Lect./Lab | 4 5 |
| MV15 | Selected topics of Polymer Chemistry and Materials Sciences | | | x | Prof. Dr. Muscat / LB Schmid | Lect./Lab | 4 5 |
| MV16 | Free-Form Surfaces | | | x | Prof. Dr. Lazar | Lect./Proj. | 4 5 |
| MF04 | Applied Didactics | | | | offered on demand | Tutorial | 2 3 |
| MF22 | Kalman Filtering in Control Systems and Communications Applications | | | | Prof. Dr. Stiehler / Prof. Dr. Mysliwetz | Lect./Exerc. | 4 5 |
| MF23 | Design of Materials | | | | Prof. Dr. Strübbe | Lect./Exerc. | 3 5 |
| MF31 | Advanced Design for Additive Manufacturing | | | | Prof. Dr. Reiß | Lect./Lab | 4 5 |
| MF38 | Chemical H2 Conversion: Applications and industrial processes | | | | Prof. Dr. Völkl | Lect./Lab | 4 5 |
| MF42 | Homogeneous Catalysis | | | | Prof. Dr. Pentlechner | Lect./Lab | 4 5 |
| MF45 | Microscopy - different methods and applications in materials science | | | | Prof. Dr. M. Müller | Lect./Exerc. | 2 3 |
| * | AW-0 0 5170.M Technical and Business English | | | | CCC | Lect. | 4 5 |
| * | AW-0 0 5160.M Business English | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5740.M Deutsch B1.1 / German B1.1 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5750.M Deutsch B1.2 / German B1.2 | | | | CCC | Lect. | 4 5 |
| ** | AW-0 0 5760.M Deutsch B2 kompakt / German B2 | | | | CCC | Lect. | 4 5 |
| | AW-0 0 6760.M Renewable Energies | | | | CCC Prof. Stier | Lect. | 4 5 |
| MP02 | Master's Project | | | | | 10 | 12 |
| VHB | Scientific writing | | | | Prof. Dr. Radon, LMU München | 2 | 3 |
| VHB | Integrated Production Systems | | | | Prof. Dr. Franke, Uni Erlangen-Nürnberg | 4 | 5 |
| VHB | Leadership and Communication in Global Business | | | | Prof. Dr. Winkler, FH Kempten | 2 | 3 |
| VHB | Machine Learning for Engineers I | | | | Prof. Dr. Eskofier, Uni Erlangen-Nürnberg | 4 | 5 |
| * for German students only: will be accepted as MF module (SPO2019 and SPO2016) restricted to a maximum of 5 Credit Points | | | | | | | |
| ** for non-German students only: will be accepted as MF module (SPO2019 and SPO2016) restricted to a maximum of 5 Credit Points | | | | | | | |
| Rev. Jan 23, 2025 | | | | | | | |

Figure 6: Engineering Sciences Master's Program – Courses expected to be offered in winter term 2025/26

Especially the table for the second next semester is not fixed yet. It may happen, that a few courses cannot be offered. Therefore, you should always think about alternatives, if one of your preferred courses will not be offered.

(You should always have an alternative for MF courses!)

3 Recommendations for your individual study plan

The master project usually starts at the end of the first semester.

The master thesis usually starts at the end of the second semester.

The order of semesters may be changed if necessary as course contents in all three semesters are independent of each other. Please note that courses are typically held once per year, i.e. either in the spring/summer term or in the fall/winter term.

The following table may be used as a template for planning the three semesters of your master program:

| Semester | Courses | CP | CP per Semester |
|----------|-------------------------|----|-----------------|
| 1 | 1 MG course (mandatory) | 5 | |
| | 1 MA course (mandatory) | 5 | |
| | 3 MV course (mandatory) | 15 | |
| | Other courses | 5 | 30 |
| 2 | Master project | 12 | |
| | 1 MG course (mandatory) | 5 | |
| | 1 MA course (mandatory) | 5 | |
| | 1 MV course (mandatory) | 5 | |
| | Other courses | 8 | 35 |
| 3 | Master thesis | 25 | 25 |

This variant is suitable if you begin your study in a winter term, because in winter term more MV courses are available.

If you begin your study in summer term, then maybe the following variant is better suitable:

| Semester | Courses | CP | CP per Semester |
|----------|-------------------------|----|-----------------|
| 1 | 1 MG course (mandatory) | 5 | |
| | 2 MA course (mandatory) | 10 | |
| | 1 MV course (mandatory) | 5 | |
| | Other courses | 10 | 30 |
| 2 | Master project | 12 | |
| | 1 MG course (mandatory) | 5 | |
| | 3 MV course (mandatory) | 15 | |
| | Other courses | 3 | 35 |
| 3 | Master thesis | 25 | 25 |

Above variants keep the third semester free for your Master thesis. This is very useful if you plan to complete your thesis in industry. Especially if the company is not near Rosenheim.

If you plan to complete your thesis in one of the labs of the university or in a company near to Rosenheim, then you can follow the next plan:

| Semester | Courses | CP | CP per Semester |
|----------|-------------------------|----|-----------------|
| 1 | 1 MG course (mandatory) | 5 | |
| | 1 MA course (mandatory) | 5 | |
| | 3 MV course (mandatory) | 15 | |
| | Other courses | 5 | 30 |
| 2 | Master project | 12 | |
| | 1 MG course (mandatory) | 5 | |
| | 1 MA course (mandatory) | 5 | |
| | 1 MV course (mandatory) | 5 | |
| | Other courses | 3 | 30 |
| 3 | Other courses | 5 | |
| | Master thesis | 25 | 30 |

Spring/Summer Term:

Lecture Period: March 15th - approx. July 7th.

Fall/Winter Term:

Lecture Period: October 1st - approx. January 20th.

The examination period in the winter semester is from about January 25th until February 15th, the examination period in the summer semester is typically from about July 5th until July 25th.

4 Remarks on Master 's project and Master thesis

4.1 Master 's project

Approximately 4 to 5 weeks before the end of the lecture period in each semester, project topics available for the next semester will be published in a separate LC course.

There will be about 2 weeks to inform yourself about the published projects and to get in contact with the offering professor. You can then apply for up to 4 projects.

In the next week after the application deadline, your prio-1-applications are forwarded to the offering professors, who decide, which student they will accept for the project.


In the following weeks, we will forward the prio-2- to prio-4-applications for those students, who didn 't get their prio-1-project to the offering professors. The goal is, that by the end of the current semester every student should know which project he or she will work on in the next semester.

In order to register the project at the examination office, you must fill out the following form:


[Master_Project_Form](#) 

The registration must be done during the first 4 weeks of the semester in which the project will be executed.

4.2 Electronic Workflow for Master thesis

The complete process of registration and submission of your thesis is supported by an electronic work- flow. Details can be found at [studies-and-further-education](#) 

4.3 Guidelines for the preparation of final thesis at the Faculty of Engineering

Before writing your final thesis, consider the [“Guidelines”](#) 

4.4 Declaration of Originality/Eigenständigkeitserklärung

Note that some written documentation (master's project report, coursework) would need a declaration of originality placed immediately after the title page.

Hiermit bestätige ich, dass ich die vorliegende Arbeit selbständig verfasst und keine anderen als die angegebenen Hilfsmittel benutzt habe. Die Stellen der Arbeit, die dem Wortlaut oder dem Sinn nach anderen Werken (dazu zählen auch Internetquellen) entnommen sind, wurden unter Angabe der Quelle kenntlich gemacht.

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

Place, Date: _____

Signature: _____

Figure 7: Declaration of Originality

5 Important notes for SPO 2019

The course titles and course numbering are taken from SPO 2023 rather than from the SPO 2019. We officially use these course titles and numbering in the curriculum as well from now on.

The following changes are noted:


- MF34 has changed to MG06 (but still applies as MF34)
- MF44 has changed to MG07 (but still applies as MF44)

6 Important notes for SPO 2016

The course titles and course numbering are taken from the SPO 2019 rather than from the SPO 2016. We officially use these course titles and numbering in the curriculum as well from now on. The following changes are noted:

- MA07 has changed to MA06 (but still applies as MA07)
- MA05 has changed to MV16 (but still applies as MA05)
- MV13 has changed to MA05 (but still applies as MV13)
- MV16 has changed to MV13 (but still applies as MV16)
- MV17 has changed to MV14 (but still applies as MV17)
- MV18 has changed to MV15 (but still applies as MV18)

7 Remarks on Module Descriptions

In the following Module descriptions in the field “Form of examination” the text “See SPO” is written. This only applies to the old SPO´s. For the new SPO (this one), examinations for all modules are defined in the examination announcements, see [“Prüfungsankündigung”](#) .

8 Course Descriptions

| Module name | | Advanced Engineering Mathematics | |
|--|--------------------|----------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MG01 | AEngMaths | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Schulze | Prof. Dr. Schulze | 70% Lecture, 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Multivariable calculus, ordinary differential equations, integral transforms | | | |
| Intended learning objectives | | | |
| <ul style="list-style-type: none"> • Knowledge of important PDE, their origin and fundamental knowledge of solution techniques • Acquire the basic theory of the most important PDE (heat-/diffusion, wave- and laplace equation), • Gain an overview of and insight in solution techniques for PDE (separation of variables, integral transforms, numerical solutions) | | | |

| Content |
|---|
| <p>Prerequisites and introduction to PDE</p> <ul style="list-style-type: none">• Surface integrals and integral theorems (Gauss and Stokes theorem)• Derivation of important PDE• Boundary conditions <p>Classical solution methods</p> <ul style="list-style-type: none">• Solution and analysis of the heat- /diffusion equation in one and three variables• Solution of the wave equation and laplace equation <p>Numerical methods - Finite differences:</p> <ul style="list-style-type: none">• heat-/diffusion equation and the stability criterion, laplace equation and numerical solution of linear systems of equations• Finite elements• Case studies in Matlab/Octave or C |
| Material |
| Problem sheets and some lecture notes |
| Recommended literature |
| <ul style="list-style-type: none">• S.J. Farlow,: Partial Differential Equations for scientists and engineers, Dover Publications, Reprint, 1993• W.A. Strauss: Partial Differential Equations. An Introduction, Wiley, 2. Edition, 2008 |

| Module name | | Electrodynamics | |
|---|---------------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MG02 | ELDyn | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Norbert Seliger | Prof. Dr. Norbert Seliger | 70% Lecture , 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Mathematics (vector calculus and analysis), Electromagnetic field basics, Matlab/Octave | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>The mathematical and physical principles of classical electrodynamics form the basis of all applications where the interaction of electromagnetic fields with technical systems is of importance, e.g. propagation of electromagnetic waves, antenna theory, electromagnetic compatibility (EMC)</p> <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Fundamental understanding of electromagnetic field theory (static, quasi-stationary and non-stationary fields) • Computation and analysis of static and time-dependent electromagnetic fields and their application in modern electronic systems • Introduction to numerical methods and FEM software for the solution of practical electrodynamics problems | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Dipole fields, multipole fields, Potential theory, Coulomb and Lorenz gauge, Maxwell capacitance matrix, Partial and loop inductance, Electromagnetic radiation (retarded potentials), Wave scattering• Computational Electrodynamics: Method of Moments, Finite Difference Time Domain, Finite Element Method• Analytical Solution of Laplace equation, e.g. by Fourier series |
| Material |
| Lecture notes, worksheets available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• H. Henke: Elektromagnetische Felder: Theorie und Anwendung, Springer, 2003• J. D. Jackson: Classical Electrodynamics, Wiley, 3. Edition, 1998• K. W. Kark: Antennen und Strahlungsfelder: Elektromagnetische Wellen auf Leitungen, im Freiraum und ihre Abstrahlung, Vieweg+Teubner, 2011• M. N. O. Sadiku: Numerical Techniques in Electromagnetics, CRC Press, 2. Edition, 2000• M. N. O. Sadiku: Elements of Electromagnetics (Oxford Series in Electrical and Computer Engineering), Oxford University Press, 2006• D. J. Griffiths: Elektrodynamik, Eine Einführung, Pearson, 3., aktualisierte Auflage, 2011 |

| Module name | | Statistics | |
|---|--------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MG04 | Statistics | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Schmiedt | Prof. Dr. Schmiedt | 70% Lecture , 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge of mathematical fundamentals | | | |
| Intended learning objectives | | | |
| <p>Specific Goals: Knowledge of the various statistical methods and a fundamental knowledge of probability calculus. Learning Objectives:</p> <ul style="list-style-type: none"> Identify stochastic / statistical aspects in every-day processes and issues, especially in technical and economic processes and issues; Gain a broad overview of basic descriptive and explorative methods of statistical data analysis and the possibilities resp. limits of its application. Acquire the foundations of probability theory and application of central inductive statistical methods. Be able to perform independently data analysis and to apply statistical methods using current statistics software (R). Knowledge and integration of the functionalities and features of popular statistics software packages; Gain the ability to independently acquire stochastic / statistical methods, to evaluate them critically and to implement them in practice using statistics software. | | | |

| Content |
|--|
| <p>I. Applied Statistics</p> <ul style="list-style-type: none">• introduction• descriptive and explorative statistics• univariate analysis• multivariate analysis• inductive statistics• point estimation• interval estimation• testing of hypotheses• linear model <p>II. Principles of probability calculus</p> <p>III. Statistics software: Introduction to data analysis with R</p> <p>IV. Tutorial assignments</p> <ul style="list-style-type: none">• theory and methods• statistics software (R) |
| Material |
| Lecture notes, exercise problem descriptions, R sample programs, demonstration of program results |
| Recommended literature |
| <ul style="list-style-type: none">• P. Billingsley: Probability and Measure. Anniversary Edition, Wiley, 2012• S. M. Ross: Introduction to Probability and Statistics for engineers and scientists, Academic Press, 4. Edition, 2009• J. Tukey: Exploratory Data Analysis, Addison-Wesley, 1977• W. N. Venables: An Introduction to R, 2014, http://www.cran.r-project.org/doc/manuals/R-intro.pdf |

| Module name | | Fluid Mechanics | |
|--|---|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MG05 | FluidMec CFD | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Buttinger | Prof. Dr. F. Buttinger, Prof. Dr. C. Schäfle | 70% Lecture , 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| none | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>The course Fluid mechanics provides a basic introduction in fluid mechanics in theory and practice. Students gain competence in analytical problem understanding and enhance their problem solving capabilities in experiments and with numerical methods. In the computer exercises “CFD-simulations” students improve their skills by using modern computational fluid dynamics (CFD) software programs and they will be able to analyze complex fluid dynamics problems</p> | | | |
| Content | | | |
| Fluid mechanics of real flows Fluid mechanics of compressible non-viscous fluids Fluid mechanics of viscous fluids Introduction to CFD simulation Simulation of compressible and incompressible fluids Laboratory experiments and validation of CFD results | | | |
| Material | | | |
| Exercise problem descriptions, sample programs, demonstration of program results | | | |

Recommended literature

- G. Junge: Einführung in die technische Strömungslehre, Hanser, 2. Auflage, 2015
- H. Kuhlmann: Strömungsmechanik, Pearson, 2. Auflage, 2014
- R. Schwarze: CFD-Modellierung: Grundlagen und Anwendungen bei Strömungsprozessen, Springer Vieweg, 2012

| Module name | | Applied numerical methods | |
|--|--|---------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MG06 | ANM | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Riß | Prof. Dr. F. Riß, Prof. Dr. F. King | 100% Lecture | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 30 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Engineering mechanics (statics, strength of materials, dynamics) • Basic knowledge in machine dynamics • Mathematic basics (matrix/vector calculus, differential equations) | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Mechanical engineering and CAE tools have a close link to applications, but do not provide any further information about the methods necessary in the background to solve the related engineering problems (every tool is a sort of 'black box'). On the other hand, classical engineering mathematics is marked with proofs, abstract thinking and no link to any engineering application.</p> <p>Learning Objectives</p> <p>Acquire the ability to apply methods of numerical mathematics to solve mechanical problems i.a. from the field of machine dynamics and get a basic understanding of the underlying numerical methods.</p> | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Coordinate transformations,• numeric matrix calculus and eigenvalue / eigenvector problems,• solution of higher-dimensional linear and non-linear systems of equations (i.a. from the field of mechanic frame structures),• numerical solution of problems from machine dynamics or multibody systems (i.a. ordinary differential equations, oscillations of rigid body systems). |
| Material |
| Lecture notes, hardcopies and/or PDF download files. MATLAB m-files for lab course. |
| Recommended literature |
| <ul style="list-style-type: none">• J. Hoffmann: MATLAB und SIMULINK - Beispielorientierte Einführung in die Simulation dynamischer Systeme, Addison-Wesley, 1999• H. Kerkele, R. Pittschellis: Einführung in die Getriebelehre, Teubner Verlag, 1998• H. Ulbrich: Maschinendynamik, Teubner Verlag, 1996 |

| Module name | | Physical Metallurgy | |
|--|-------------------------|----------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MG07 | PhysMet | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. A. Schneeweis | Prof. Dr. A. Schneeweis | 75% Lecture, 25% Lab | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 45 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 15 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Introductory Materials Engineering course | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Students will consider the thermodynamic and kinetic principles governing the behavior of metals and alloys, particularly with respect to their influence on the formation and evolution of microstructure. The course is designed to provide the background necessary to understand the physical and mechanical properties of metals and how these properties are affected by composition, mechanical deformation and heat treatment.</p> <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Describe how and why phase changes (liquid-solid or solid-solid) occur in metallic materials and the parameters that can be used to control these changes. • Identify and characterize microstructures in various ferrous and non-ferrous metals and the processing steps that produced them. • Select metal alloys and/or heat treatments to meet specific performance requirements. | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Thermodynamics and Phase Diagrams• Substitutional and Interstitial Diffusion• Crystal Interfaces and Microstructure; Kinetics• Nucleation and Solidification• Solid State Transformations (Precipitation hardening, Annealing)• Diffusionless Transformations |
| Material |
| Lecture notes |
| Recommended literature |
| <ul style="list-style-type: none">• R. Abbaschian, R. Reed-Hill: Physical Metallurgy Principles, Cengage Learning, 4th Edition, 2008• D.A. Porter, K.E. Easterling: Phase Transformations in Metals and Alloys, CRC Press, 4th Edition, 2021• W. Kurz, D.J. Fisher: Fundamentals of Solidification, CRC Press, 4th Edition, 1998 |

| Module name | | Real-Time Systems | |
|--|------------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MA01 | RTSys | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. B. Mysliwetz | Prof. Dr. B. Mysliwetz | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Engineering Sciences Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> Working principles of microprocessors (IO, interrupts, stack). Programming experience in a blockstructured high level language, preferably ANSI C or C++. Basic knowledge of structure and working principles of a 'general purpose' operating system. Fundamental knowledge of the functional units of a personal computer. Fundamentals of control theory. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <ul style="list-style-type: none"> To enable students to design and implement software for real-time applications <p>Learning Objectives:</p> <ul style="list-style-type: none"> Understand the mechanisms and problems associated with real-time applications Apply real-time software design rules Know the working principles and utilize the services of real-time operating systems, Realize the advantages of using real-time operating systems | | | |

| Content |
|---|
| <p>Part I</p> <ul style="list-style-type: none">• Real-Time Software Design and Real-Time Operating Systems (Mysliwetz) Technical terms and definitions;• examples of embedded real-time systems; real-time operating system concepts; processes, threads, tasks; scheduling principles; real-time software design;• rate-monotonic scheduling approach; reentrant code; semaphores, mutual exclusion, shared resources; synchronization mechanisms; deadlocks;• priority inversion; interprocess communication, overview of commercial real-time operating systems; practical laboratory exercises. <p>Lab (Part I)</p> <ul style="list-style-type: none">• Processes and Threads under Windows; Analysis of Fundamental Real- Time Properties of Windows on a PC;• implementing a step motor control application with the real-time kernel uC/OS on an ARM Cortex-M based microcomputer;• application of semaphores as a mutual exclusion mechanism while accessing shared resources, effect of priority inversion. <p>Part II</p> <ul style="list-style-type: none">• PC-based Real-Time Control Systems (Schittenhelm) Real-time applications based on personal computers;• requirements, hardware and software design, overview and comparison of commercial PC-based systems. <p>Lab (Part II)</p> <ul style="list-style-type: none">• PC-based real-time systems via OPC-servers;• Windows-CE development environment;• real-time programming under VxWorks. |
| Recommended literature |
| <ul style="list-style-type: none">• Lecture notes, worksheets and lab-class problem descriptions available as PDF download files• Labrosse, J. J: MicroC/OS-II - The Real-Time Kernel, CMP Books, 1999• Tanenbaum, A. S.: Modern Operating Systems, Prentice Hall, 1992• Brause, R.: Betriebssysteme - Grundlagen und Konzepte, Springer, 2001• Iwanitz, F., Lange, J.: OPC Fundamentals, Implementation and Application, Hüthig-Verlag, 2006• Stallings, W.: Operating Systems: Internals and Design Principles, Prentice Hall, 2014 |

| Module name | | Integrated Circuit System Design and Test | |
|---|---------------------|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MA02 | - | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Versen | Prof. Dr. M. Versen | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | h |
| + Lab course | + Exam preparation | | |
| 30 h | 60 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Familiarity with digital logic and switching circuits; basic knowledge of a hardware descriptions level programming language. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals: To enable students to design complex digital circuits (ASICs or FPGAs) and systems using architecture optimization at RTL level, different synthesis steps, system simulation and implementation</p> <p>To enable students to verify and test IC systems and to use test system</p> <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Understanding the fundamentals of digital VLSI circuit design methodology. • Design digital VLSI (or SoC) circuits using appropriate design tools to determine and optimize a RTL level architecture, to verify the model behavior by simulation and to synthesize the model into an ASIC. • Understand the fundamental problems associated with fail observation and analysis. Use of test systems and design for test methods to ensure system debug and product engineering | | | |

| Content |
|--|
| Design of Digital Integrated VLSI Circuits : Introduction to Logic Design, Creating Digital Designs and the Digital Chip Design Development Flow Design methodology : Introduction to Synthesis, Timing, Floorplanning, Power Planning, Placement, Clock Tree Synthesis, Logic Equivalence Checking, Static Timing Analysis, Gate Level Simulation, Density & Signoff-Checks and Chipfinishing Test of Integrated Systems: Basic Function of Integrated Circuits, Failure and Defect Models, Observing and Detecting Failures, Fundamentals of Digital Test, Hardware Test Setups. |
| Material |
| Literature and lab-class tutorial and problem descriptions |
| Recommended literature |
| <ul style="list-style-type: none">• H. Kaeslin: Digital Integrated Circuit Design, Cambridge University Press, 2008• H. Kaeslin: Top-Down Digital VLSI Design, Morgan Kaufmann, 2014• -: Cadence Training and Lab Material, Cadence Inc, 2020• J. Segura, C. F. Hawkins: How it Works, How it Fails, IEEE Press, 2004• -: Training Tutorial of the Hilevel Griffin System, Hilevel Technology Inc., 2005 |

| Module name | | Mixed Signal Systems | |
|---|--------------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MA03 | MixSigSys | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Stubenrauch | Prof. Dr. F. Stubenrauch | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Good knowledge of the representation of continuous and time discrete signals in the time and frequency domain; • fundamentals of digital signal processing, analogue and digital circuit design. | | | |

| Intended learning objectives |
|--|
| <p>Specific Goals:</p> <ul style="list-style-type: none"> • To enable students to design mixed signal systems in a professional manner with respect to the properties of real world data converters Assess the properties of data converters as given in the corresponding data sheets in order to select appropriate components for a mixed signal application • Evaluate the properties of data converters and mixed signal systems by measurement and hardware characterization • To enable students to design mixed signal systems in a professional manner with respect to the properties of real world data converters <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Understand the fundamental problems associated with analogue to digital and digital to analogue conversion in real world mixed signal systems • Assess the properties of data converters as given in the corresponding data sheets in order to select appropriate components for a mixed signal application • Evaluate the properties of data converters and mixed signal systems by measurement and hardware characterization |
| Content |
| <p>Fundamentals of data conversion, discrete and fast Fourier transform including the use of windows, analogue and quantization noise, voltage references, static and dynamic properties of data converters, fast ADC and DAC architectures, mixed signal design guidelines</p> |
| Material |
| <p>Book like lecture notes and problem sheets including detailed solutions</p> |
| Recommended literature |
| <ul style="list-style-type: none"> • Book like lecture notes and problem sheets including detailed solutions • M. J. Demler: High Speed Analog to Digital Conversion, Academic Press, 1991 • D. F. Hoeschele: Analog to Digital and Digital to Analog Conversion Techniques, Wiley, 1994 • W. Kester et al.: High Speed Design Techniques, Analog Devices Inc., 2010 (http://www.analog.com/en/technical-documentation/resources/index.html) • W. Kester et al.: Mixed Signal and DSP Design Techniques, Analog Devices Inc., 2009 (http://www.analog.com/en/technical-documentation/resources/index.html) • R. A. Pease: Troubleshooting Analog Circuits, Newnes, 1991 • H. Zumbalen: Linear Circuit Design Handbook, Analog Devices, 2008 • -: Training Tutorial of the Hilevel Griffin System, Hilevel Technology Inc., 2005 |

| Module name | | Selected Topics in Assembly Technology | |
|---|------------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MA04 | AssemTe | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. C. Meierlohr | Prof. Dr. C. Meierlohr | 60% Lecture, 40% Exercise | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 40 h | 40 h | 20 h |
| + Lab course | + Exam preparation | | |
| 20 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge in assembly and manufacturing processes and assembly organization | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <ul style="list-style-type: none"> Have in-depth knowledge in selected joining processes, in using technical equipment for part supply and in applying state-of-the-art methods for planning assembly systems <p>Learning Objectives:</p> <ul style="list-style-type: none"> Have in-depth knowledge in selected joining techniques and processes Have in-depth knowledge in selected technologies and equipment for assembly Be able to carry out the design of assembly systems with special attention to state-of-the-art strategies and planning methods Have knowledge about and be able to optimize existing assembly systems | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Design for assembly• Automation Potential Assessment• Bonding with adhesives: methods and technology• Handling processes and equipment for automated part supply• Manual assembly: digital planning tools for ergonomics and productivity• Manual assembly: worker assistance• Hybrid assembly: human-robot-collaboration• System design: Toyota Production System |
| Material |
| Lecture notes and lab-class problem descriptions |
| Recommended literature |
| <ul style="list-style-type: none">• Lecture notes,• S. Hesse: Grundlagen der Handhabungstechnik, Carl Hanser, 6. Auflage, 2024• T. Jüntgen: Klebtechnik – klebgerechte Konstruktionen und Anwendungen in der Praxis., Vogel Communications Group, 1. Auflage, 2018• B. Lotter: Montage in der industriellen Produktion, Springer, 2. Auflage, 2012• G. Spur: Handbuch Fügen, Handhaben und Montieren, Carl Hanser, 2013• A. Wolf: Grippers in Motion – The Fascination of Automated Handling Tasks, Carl Hanser, 2018• A.C. Bullinger-Hofmann: Homo sapiens digitalis, Springer, 2016 |

| Module name | | Model-Based Development | |
|---|----------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MA05 | MBD | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Perschl | Prof. Dr. F. Perschl | 75% Lecture, 25% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 45 h | 30 h | 15 h |
| + Lab course | + Exam preparation | | |
| 15 h | 45 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Basic knowledge of Matlab/Simulink/Stateflow | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <ul style="list-style-type: none"> • In this lecture students will get profound knowledge about many aspects of model based development for embedded systems and state-of-the-art development methods in various industries like automotive, aerospace and consumer industries. • Also, the students will learn to apply basic aspects of modelling and simulating dynamic systems with TheMathworks tool chain. • Furthermore they will learn how to use the dSpace tool chain for rapid control prototyping and code generation for embedded systems. <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Students will know and be able to use modern software development methods for embedded systems. • Students will be able to solve problems in the field of control of mechatronic, mechanical or electronic systems with the help of simulation, rapid control prototyping and deploying to real hardware. • Students will learn to use TheMathworks and dSpace tools. | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Definition and basics of model based development• Basics on modelling dynamic systems with Simulink• dSPACE tool chain (RTI, ControlDesk, Hardware)• Aspects of real-time programming / multivariate control• Modelling of discrete states with Stateflow• Advanced modelling techniques |
| Material |
| Lecture notes |
| Recommended literature |
| <ul style="list-style-type: none">• A. Angermann, M. Beuschel, M. Rau, U. Wohlfarth: Matlab Simulink - Stateflow, De Gruyter Oldenbourg, 10. Auflage, 2020• H. Lutz, W. Wendt: Taschenbuch der Regelungstechnik mit Matlab und Simulink, Europa Lehrmittel, 12. Auflage, 2021• TheMathworks: Matlab documentation• dSpace: HelpDesk• Prof. Dr.-Ing. Franz Perschl: Model-Based Development, Lecture notes• Prof. Dr.-Ing. Franz Perschl: Model-Based Development, Lab Course descriptions |

| Module name | | Materials from Renewable Resources | |
|--|------------------------|------------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MA06 | MatRenew | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. J. Schroeter | Prof. Dr. J. Schroeter | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer and winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Chemistry; Material Science | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <ul style="list-style-type: none"> Goals Provide knowledge about materials, whose biomass feedstocks are provided by nature annually. <p>Learning Objectives:</p> <ul style="list-style-type: none"> Learning Objectives Definitions History of mankind's use of materials from renewable resources (MFRR) Present impact Survey of materials | | | |
| Content | | | |
| <ul style="list-style-type: none"> Statutes, standards, guidelines, certification History of mankind's use of MFRR (wood, natural fibres, leather, rubber, colourants) Present impact for the environment and for sustainable feedstock supply Survey of materials available (plastics/ non-plastics/ additives) Life cycle analysis | | | |

| Material |
|---|
| Lecture notes, worksheets available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• D. Kaplan: Biopolymers from renewable resources, Springer, 1998• T. Scheper (ed.): Biopolyesters. Advances in biochemical engineering/ Biotechnology. Vol. 71., Springer, 2001• H. Endres, A. Siebert-Raths: Technische Biopolymere, Hanser, 2009• D. Fengel, G. Wegener: Wood: Chemistry, Ultrastructure, Reactions, de Gruyter, 1984• M. Belgacem, A. Gandini: Monomers, Polymers and Composites from Renewable Resources, Elsevier, 2008 |

| Module name | | Microelectronics | |
|--|--------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF01 | MicroEl | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Popp | Prof. Dr. Popp | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> Working principles of semiconductor devices. DC- and AC-description of MOS- and bipolar-devices. Basic familiarity with SPICE-modelling. | | | |
| Intended learning objectives | | | |
| Enable students to understand the principles of full custom design and fabrication of integrated circuits | | | |
| Content | | | |
| <p>Lecture:</p> <ul style="list-style-type: none"> Semiconductor technology (layer growth, doping, masking, mounting). MOS- and BIP- Circuit integration, layout-rules, dimensioning with typical examples. <p>Lab class:</p> <ul style="list-style-type: none"> On-wafer measurements of MOS and BIP-devices and circuits. Electrical characterisation, SPICE-parameter extraction. Mounting and bonding of a small IC. Layout exercises. SPICE-simulations. | | | |

Recommended literature

- N. Weste, K. Eshragian: Principles of CMOS VLSI Design, Addison Wesley, 1994
- S. M. Sze: VLSI Technology, John Wiley, 1990

| Module name | | Applied Didactics | |
|---|---------------------|---------------------------|--|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF04 | - | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr.-Ing. F. Perschl | dependent on module | 100% Tutorial | - |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term / winter term | German or English, in agreement with the responsible professor / teacher |
| Total workload | = Presence | + Self-study | + Exam preparation |
| 150 h | 150 h | h | h |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Excellent professional skills of the subjects, the student has to teach. • This course 'Applied Didactics' can be chosen only in agreement with the professor / teacher, who is responsible for lab class or exercise. | | | |
| Intended learning objectives | | | |
| A deeper understanding of selected basic engineering topics ('learning by teaching') and of didactic concepts in engineering education. | | | |
| Content | | | |
| Work as a tutor, supervising students in lab courses or exercises. (Number of ECTS-Points may vary from 3 to 5 and depends on the necessary workload between 90 and 150 hours.) | | | |
| Recommended literature | | | |
| <ul style="list-style-type: none"> • Depends on selected course for tutorial | | | |

| Module name | | Electronic Packaging and Manufacturing | |
|--|---------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF10 | MicroPack | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Winter | Prof. Dr. M. Winter | 80% Lecture, 10% Exercises, 10% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 50 h | 30 h | 20 h |
| + Lab course | + Exam preparation | | |
| 10 h | 40 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge of analysis and design of analog circuits. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Students shall get an overview and understanding about packaging technologies used for electronic devices as ICs and sensors and the impact of each technology on the system performance and reliability. Furthermore the students should be enabled to integrate electronic devices on system level (second-level assembly).</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Understand basics of material science involved in electronic packaging with focus on reliability • Common technologies for mounting integrated circuits and sensor chips on carriers and for providing electrical interconnections. • Technologies for substrate configuration, component assembly technology and encapsulation including relevant application examples from state-of-the-art development for consumer and automotive products like MEMS sensors (pressure sensors, gas sensors, microphones). • The students should be able to identify and to assess the interdependencies between chip design, miniaturization issues, system performance and packaging technology. • Understanding of common failure modes and method for defect analysis (X-ray, CT-scan, ultrasonic microscope, mechanical grinding) | | | |

| Content |
|---|
| <p>Challenges and definitions of microelectronics packaging, IC and MEMS sensors backend manufacturing processes, first-level packaging:</p> <ul style="list-style-type: none">• Integrated circuit packaging, sensor packaging and interconnection• Lead frames, die bonding• Wire bonding• Flip Chip Technology (FC)• Chip Size Packages (CSP)• Wafer Bonding (WB)• Through Hole Technology (THT)• Area array packages• Ball Grid Arrays (BGA)• Substrates: Organic substrates, Single and multilayer printed circuit boards , Multilayer cofired ceramic technology (HTCC and LTCC)• Polymers• Encapsulation: Molding, Glob Top• Second-level packaging: board assembly processes• Surface Mount Technology (SMT)• Third level: Interconnects and switches• basics of involved material science• manufacturing processes |
| Material |
| Lecture notes, multimedia presentations |
| Recommended literature |
| <ul style="list-style-type: none">• R. Tummala: Fundamentals of Microsystem Packaging, McGraw-Hill, 2. Edition, 2019• C. Harper: Electronic Packaging and Interconnection Handbook, McGraw-Hill, 4. Edition, 2004 |

| Module name | | Power Electronic Circuit Design | |
|---|----------------------|---------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF14 | PowerElec | ING M1-3 | 3 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. N. Seliger | Prof. Dr. N. Seliger | 70% Lecture, 30% Exercises | 2 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 90 h | 30 h | 15 h | 15 h |
| + Lab course | + Exam preparation | | |
| 0 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge in power electronics, electrical circuits, semiconductor devices, Python/LTSPICE basics | | | |
| Intended learning objectives | | | |
| <ul style="list-style-type: none"> Design of complex power electronic circuits based on specifications. Ability to select the proper topology and calculate and simulate (Python, LTSPICE) voltage and current transients in power semiconductor elements and passive components. Layout rules for power electronic circuits. Cooling solutions, thermal management. Interfacing with digital signal processing. | | | |
| Content | | | |
| <ul style="list-style-type: none"> Electrical Design: Topology Selection, Circuit Design, Losses in Power Semiconductors, Power Passives (Inductors, Transformers, Capacitors), Simulation (Python, LTSPICE), Layout, Isolation Coordination Thermal Design: Thermal Impedance, Thermal Management, Reliability Issues, Case studies and Lab experiments | | | |
| Material | | | |
| Lecture notes, worksheets available as PDF downloads | | | |

Recommended literature

- N. Mohan: Power Electronic Circuits, Wiley, 2003
- R. Erickson: Fundamentals of Power Electronics, Springer, 3. Edition 2020
- W. Yang: Circuit Systems with MatLab and PSPICE, Wiley, 2008
- I. Batarseh: Power Electronic Circuits, Wiley, 2. Edition, 2018

| Module name | | RF and Microwave Systems | |
|--|--------------------------|----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF20 | RFSys | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. P.S.H. Leather | Prof. Dr. P.S.H. Leather | 50% Lecture, 50% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | 65 h |
| + Lab course | + Exam preparation | | |
| 0 h | 25 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge in power electronics, electrical circuits, semiconductor devices, Python/LTSPICE basics | | | |
| Intended learning objectives | | | |
| <ol style="list-style-type: none"> 1. Develop an overall picture of radio and microwave systems, primarily for communications. 2. Understand performance requirements and how they relate to system specifications. 3. Learn about various transceiver architectures, their merits and costs. 4. Derive system specifications from wireless communication standards. 5. Calculate an end-to-end link budget, develop a level plan and create system-level behavioural models. | | | |

| Content |
|---|
| <ol style="list-style-type: none"> 1. Modulation, Transmitters and Receivers Receiver, transmitter and transceiver architectures RF signals Analogue and digital modulation Interference and distortion Early receiver technology Modern transmitter architectures Modern receiver architectures 2. Antennas and the RF Link RF antennas Radiation from a current filament Resonant antennas Traveling-wave antennas Fundamental antenna parameters The RF link Radio link interference 3. RF Systems Broadcast, simplex, duplex, duplex and multiplex Cellular communications Multiple access schemes Spectrum efficiency Cellular phone systems Generations of radio 4G, fourth generation radio: beyond 3G and LTE family 5G, fifth generation radio: beyond 4G |
| Material |
| <p>The course is based mainly on reference A, in particular chapters 2-4. Additional material may also be sourced from references B-G. Students should be able to derive their notes from course lectures.</p> |
| Recommended literature |
| <ul style="list-style-type: none"> • M. Steer: Microwave and RF Design, Volume 1: Radio Systems, NC State University, 3. Edition, 2019 • H. De Los Santos: Radio Systems Engineering, Springer, 2015 • W. Egan: Practical RF System Design, Wiley, 2003 • C. Bowick: RF Circuit Design, Newnes, 2007 • J. B. Hagen: Radio-Frequency Electronics, Cambridge, 1996 • K. M. Gharaibeh: Non-linear Distortion in Wireless Systems, Wiley, 2012 • L. Smaïni: RF Analog Impairments Modeling for Communication Systems Simulation, Wiley, 2012 • E. McCune: Practical Digital Wireless Signals, Cambridge, 2010 |

| Module name | | Kalman Filtering in Control Systems and Communications Applications | |
|--|--|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF22 | Kalman | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. B. Mysliwetz, Prof. Dr. M. Stichler | Prof. Dr. B. Mysliwetz, Prof. Dr. M. Stichler | 25% Lecture, 75% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 15 h | 30 h | 45 h |
| + Lab course | + Exam preparation | | |
| 30 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Familiarity with MATLAB and C (or C++) programming. • Course MV01 Advanced Control Systems is strongly recommended. • Passing of assessment test is required for admission. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Enable students to understand the working principles and application areas of recursive estimation methods and to design and implement numerically efficient and stable algorithms for state and parameter estimation. Practical implementation and analysis is done within a lab project</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Know application areas of state and parameter estimation approaches • Understand central working principles and algorithms of recursive estimation methods • Be aware of potential numerical problems and the computational load of different mathematical formulations of KF algorithms • Gain hands-on application experience in KF design, filter tuning and embedded implementation | | | |

| Content |
|---|
| <ul style="list-style-type: none"> • Introduction Background, Motivation and Application Fields of Kalman Filtering • Mathematical Fundamentals Matrix Algebra Basics, Linear Systems Theory, Discretization • Probability Theory Fundamentals Random Variables, Stochastic Processes, White Noise • State Space Model of a Dynamic System Continuous-Time vs. Discrete Time, State Observer, Observability • Least Squares Estimation • Propagation of States and Covariances • The Discrete-Time Kalman Filter • Alternate Filter Formulations Factorization, Square Root Filters, Nonlinear/Extended Kalman Filter • Special Topics Resolving Numerical/Stability Problems, Filter Tuning • Practical Lab Projects/Exercises e.g.: Position and Motion-Estimation from Image Processing Data, Carrier Phase Recovery in a Receiver/Demodulator, Position- and Motion- Estimation for Inertial Navigation |
| Material |
| Lecture notes, worksheets and lab-class problem descriptions available as PDF download files |
| Recommended literature |
| <ul style="list-style-type: none"> • D. Simon: Optimal State Estimation. Kalman, H Infinity, and Nonlinear Approaches, Wiley, 2006 • B. P. Gibbs: Advanced Kalman Filtering, Least-Squares and Modeling: A Practical Handbook, Wiley, 2011 |

| Module name | | Design of Materials | |
|---|----------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF23 | DoM | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Nicole Strübbe | Prof. Nicole Strübbe | 66% Lecture, 33% Lab course | 3 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 20 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 40 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Basic course in polymer chemistry and extrusion | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>The students should learn how to design/achieve specific needed material properties, e.g. corrosion protection, scratch resistance, low shrinkage in thermoplastics, elastomers as well as in paints and coatings.</p> <p>Learning Objectives</p> <p>To gain the knowledge and competence how to use fillers and additives in plastics or how to create material combinations (plastic - plastic, wood - plastic, metal - plastic, etc) to achieve enhanced material/composite properties.</p> | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Definition of terms: additives, pigments, fillers• Additives in General*Polymer Compounds• Fillers: Classification of Fillers, Particle morphology of Fillers, Fillers and their function, Rules of Mixtures, Effect of Filler, Form of Filler, Dispersing and Grinding, Interaction between particles• Methods for particle incorporation• Extrusion• Dissolver• Triple roll mill• High Speed agitator ball mill• Application examples and recipes in thermoplastics, paints and coatings and elastomers• Methods for testing specific filler properties e.g. color, oil absorption;• Methods for testing specific application properties e.g. scratch resistance, corrosion protection; |
| Material |
| Creation of own extruder screw configuration Lecture notes, worksheets and lab-class problem descriptions available as PDF download files |
| Recommended literature |
| <ul style="list-style-type: none">• Ceresana: Füllstoffe, Market Study, 2016• J. C. J. Bart: Additives In Polymers: Industrial Analysis And Applications, Wiley, 2005• D. Gysau: Füllstoffe, Vincentz Network, 3. überarbeitete Auflage, 2014• P. Eyerer, T. Hirth, P. Elsner: Polymer Engineering, Springer, 2008• M. Xanthos: Functional Fillers for Plastics, Wiley, 2. Edition, 2010• D. Walter, Deutsche Forschungsgemeinschaft (DFG): Nanocomposites: Primary Particles – Agglomerates – Aggregates, Wiley, 2013• J. Winkler: Dispergieren von Pigmenten und Füllstoffen, Vincentz Network, 2010• Hoffmann Mineral GmbH: www.hoffmann-mineral.com |

| Module name | | Ceramics and other Sintering materials | |
|--|--------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF24 | Ceramics | ING M1-3 | 3 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Müller | Prof. Dr. Müller | 50% Lecture, 50% Lab course | 2 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 90 h | 15 h | 15 h | 15 h |
| + Lab course | + Exam preparation | | |
| 15 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Intended learning objectives | | | |
| Enable students to understand the specific properties and production methods of ceramic materials and the resulting different applications | | | |
| Content | | | |
| <ul style="list-style-type: none"> • powders: properties and production methods • feedstock composition • forming technologies • sintering • mechanical properties: K_{IC}, Weibull-Statistics, life-time prediction • oxide-ceramics • non-oxide-ceramics • functional ceramics • lab-course: manufacturing of ceramics according different methods, determination of properties | | | |

| Module name | | Experimental modeling and simulation | |
|---|--------------------|--------------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF30 | ExModSim | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Zentgraf | Prof. Dr. Zentgraf | 100% Lecture | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 0 h | 15 h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| no formal Prerequisites, but recommendations are from mathematics linear differential equations, Laplace transformation, vector algebra and MATLAB/Simulink | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <ul style="list-style-type: none"> • methods to describe physical systems mathematically, • coding the methods into MATLAB/Simulink, • checking of program inputs and outputs <p>Learning Objectives</p> <ul style="list-style-type: none"> • modelling of physical systems applied to real simple and complicated systems, • self-coding of the methods from bottom up and evaluating of results (no click-and-look usage of existing programs) | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Principals of physical modelling,• experimental meodelling methods,• coding of the methods,• checking of the methods,• application of the methods on real, non-trivial systems |
| Material |
| Lecture notes |
| Recommended literature |
| <ul style="list-style-type: none">• J. Crassidis, J. Junkins: Optimal Estimation of Dynamix Systems, Chapman & Hall/CRC, 2004 |

| Module name | | Advanced Design for Additive Manufacturing | |
|---|--------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF31 | ADAM | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Riß | Prof. Dr. Riß | 100% Lecture | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 60 h | 15 h |
| + Lab course | + Exam preparation | | |
| 30 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| CAD, FEM, Lightweight design | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Designing parts dedicated to additive manufacturing</p> <p>Learning Objectives</p> <p>Getting the ability to take the full potential of AM parts based on applying the right way of designing additive manufacturing parts</p> | | | |
| Content | | | |
| <ul style="list-style-type: none"> • introduction in additive manufacturing • Product development for Additive Manufacturing • design rules | | | |
| Material | | | |
| Lecture notes | | | |

| Module name | | Intellectual Property Protection | |
|---|--------------------|----------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF32 | IPP | ING M1-3 | 3 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| LB Hermann Wagner | LB Hermann Wagner | 100% Lecture | 2 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 90 h | 30 h | 0 h | 15 h |
| + Lab course | + Exam preparation | | |
| 30 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| none | | | |
| Intended learning objectives | | | |
| <ul style="list-style-type: none"> • The students get an introduction to the use of ideas for their technical product developments • They learn the basics for the successful registration and defense of their industrial property right • They can research and evaluate property rights in databases and assess their importance for their own applications; • They can prepare patent applications for their inventions | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Overview of the industrial property rights patent, utility model, design and trademark;• search methods for industrial property rights;• formulation and registration of industrial property rights;• effect and scope of protection of industrial property rights;• appeal for industrial property rights;• measures against infringements of property rights;• economic significance and utilization of property rights (innovations management);• inventor rights for employees;• copyright in the field of science and technology |
| Material |
| lecture notes available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• lecture notes• www.dpma.de• www.epo.org• www.wipo.int |

| Module name | | Heat Transfer | |
|---|----------------------|----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF33 | Heat Xfer | ING M1-3 | 3 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. S. Stanzel | Prof. Dr. S. Stanzel | 70% Lecture, 30% Exercises | 2 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 90 h | 30 h | 30 h | 15 h |
| + Lab course | + Exam preparation | | |
| 0 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| basic principles of heat transfer mechanisms and basics of fluid mechanics, partial differential equations | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Knowledge and application of heat transfer mechanisms with regard to technical applications</p> <p>Learning Objectives</p> <p>Know heat transfer mechanisms and assign them to technical applications, solve heat transfer problems, analyze applications with regard to heat transfer</p> | | | |
| Content | | | |
| <ul style="list-style-type: none"> • heat conduction: steady state and transient, one dimensional and selected multidimensional, with different boundary conditions • heat transfer by convection and radiation • applications: fin design, heat exchanger design | | | |

Recommended literature

- J. H. Lienhard: A Heat Transfer Textbook, Phlogiston Press, 2019

| Module name | | Trajectory Planning for Robots and Automatic Machines | |
|--|--------------------|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF36 | TPRAM | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. King | Prof. Dr. King | 60% Lecture, 20% Exercises, 20% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 50 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 20 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> Fundamentals of linear algebra (vectors, matrices, coordinate systems). Fundamentals of control engineering and Fourier analysis. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <ul style="list-style-type: none"> Enable students to generate desired paths and trajectories for robots and multi-axes mechatronic systems. Analyze the resulting trajectory with regard to its basic properties and the tendency to generate oscillations. <p>Learning Objectives</p> <ul style="list-style-type: none"> Describe robots and other mechatronic systems with one or more axes with regard to the kinematic structure using multiple coordinate systems. Generate different types 1D desired trajectories for the movement of 1D systems. Generate path and trajectory for Cartesian and point-to-point movement of robots and multi-axes systems as an input to the servo control system. Simulate, visualize and analyze the generated trajectories and paths using Matlab. | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Necessary fundamentals of robotic theory: introduction to robotics, kinematics (translational, rotational). Introduction to trajectory and path planning.• 1D trajectory planning: basic motion profiles, composition of motion profiles, multi-point trajectories, dynamic analysis of trajectories.• Multi-dimensional trajectories and path planning: point-to-point movement based on motion profiles, Cartesian movement in 2D and 3D space including orientation interpolation. |
| Material |
| Lecture notes, worksheets and lab course problem descriptions available as PDF for download; Matlab files to demonstrate examples. |
| Recommended literature |
| <ul style="list-style-type: none">• R.N. Jazar: Theory of Applied Robotics, Springer, 2010• L. Biagiotti, C. Melchiorri: Trajectory Planning for Automatic Machines and Robots, Springer, 2008 |

| Module name | | Chemistry of renewable resources | |
|---|--|----------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF37 | CRR | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. List / Prof. Dr. Pentlehner | Prof. Dr. List / Prof. Dr. Pentlehner | 75% Lecture, 25% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 45 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 15 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| basic knowledge in chemistry | | | |
| Intended learning objectives | | | |
| <p>Specific Goals overview and knowledge about the chemistry of renewable resources. Different types of resources, pathways, applications.</p> <p>Learning Objectives definitions, advantage and disadvantages compared to fossil raw materials, pathways for renewable resources, applications</p> | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Biorefinary: from renewable resources to chemicals and pharmaceuticals• Chemical modifications of chemicals from renewable resources, e.g. Celluloseacetate, ...• Bulk chemicals from renewable resources”• Biopolymers• Fats and oils• Carbohydrates• Lignin• Amino acids and proteins• Others, e.g. terpenoids, vitamins” |
| Material |
| lecture notes available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• specific literature for each chapter |

| Module name | | Chemical H2 Conversion: Applications and industrial processes | |
|---|--------------------|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF38 | ChemCon | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Völkl | Prof. Dr. Völkl | 50% Lecture, 25% Exercises, 25% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 30 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| basic knowledge in chemistry, thermodynamics and (process) modelling | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Students should get in-depth knowledge of Hydrogen conversion processes</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Understand the different routes for Hydrogen conversion based on desired products and origin of hydrogen • Understand the material cycle of the chemical industry and bring this in context to new developments • Compare different routes based on economical and sustainability quality parameters • Analyze the different processes to get all reactants for the conversion processes beside Hydrogen • Deepen the understanding of Hydrogen conversion processes by working on an individual case study of a selected example of a Hydrogen conversion process” | | | |

| Content |
|---|
| <ul style="list-style-type: none">• overview of Hydrogen conversion processes• overview of the material cycle of the chemical industry• overview of different sources for all important components of the material cycle• Introduction of economical and sustainability performance indicators• Comparision of different routes of hydrogen conversion processes• Individual case study on a selected example of a hydrogen conversion process |
| Material |
| lecture notes available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• Specific literature for each chapter, current papers. |

| Module name | | International Master Summer School | |
|---|--------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF39 | - | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Perschl | Prof. Dr. F. Riß | 50% Lecture, 25% Exercises, 25% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 40 h | 50 h | 20 h |
| + Lab course | + Exam preparation | | |
| 20 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master. This course is the same as MF31 (Advanced Design for Additive Manufacturing) and offered as a block course during the summer school. Enrollment is limited, see the separate announcement for the summer schools in the winter term. You can only take MF31 or MF39, not both. | | | |
| Recommended prerequisites | | | |
| Basic knowledge in 3D-CAD | | | |

| Intended learning objectives |
|--|
| <p>Specific Goals</p> <ul style="list-style-type: none">• Basic concept of this course is to transmit short overviews and insights into today´s tools and methods transitioning fast to practical examples in personal exercises and workshops. The examples origin from actual situations or compressed typical situations in industrial use.• Students gain basic knowledge on Additive Manufacturing Technologies. Based on practical design and manufacturing lessons in the workshop, all participants get in direct contact with the total process chain. <p>Learning Objectives</p> <ul style="list-style-type: none">• understand and experience data analysis methods and practical use of artificial intelligence• transfer the ideas of Lean Management to different corporate sectors of producing units• classify and evaluate occurring industrial situations into change and future proof concepts• obtain insights into the concept of emission trading and its challenges• develop an understanding of what does it take to be a successful leader in international setting.• Understand the basic terminology and processes of Additive Manufacturing• utilize methods in design for layer-wise technology• recognize the complete end-to-end process• understand the challenges of designing parts and operating machines. |
| Content |
| <ul style="list-style-type: none">• Digital Technologies• Artificial Intelligence Basics• Lean Managment• EU Emissions Trading• Gear Design• Additive Production Technology• Construction of parts• Manufacturing• Quality Management• Post-Processing• Assembly and Testing” |

Recommended literature

- F. Balsliemke, A. Behrens: Einstieg in Lean Administration, Springer Gabler, 2019
- F. Bertagnolli: Lean Management: Einführung und Vertiefung in die japanische Management-Philosophie, Springer Gabler, 2.Auflage, 2020
- A. Burgess: The Executive Guide to Artificial Intelligence, Palgrave Macmillan, 2018
- T. Kollmann: E-Business, Springer Gabler, 7.Auflage, 2019
- S. Radzevich: Dudley's Handbook of practical gear design and manufacture, CRC Press, 2016
- D. Whetten, K. Cameron: Developing Management Skills, Pearson, 9.Auflage, 2015
- I. Gibson: Additive manufacturing technologies - 3D printing, rapid prototyping, and direct digital manufacturing, Springer, 2015
- O. Diegel, A. Nordin, D. Motte: A Practical Guide to Design for Additive Manufacturing, Springer, 2020
- A. Gebhardt: Understanding additive manufacturing - rapid prototyping, rapid tooling, rapid manufacturing, Hanser, 2011

| Module name | | Homogeneous Catalysis | |
|--|--------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF42 | - | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Völkl | Prof. Dr. Völkl | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 30 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| profound knowledge in chemistry | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <ul style="list-style-type: none"> overview and knowledge about the catalytic methods in chemistry, e.g. heterogeneous, homogeneous, transition metal catalysis or organocatalysis. Understanding of the working principle (reaction mechanism) of homogeneous catalyst. Ability to run experiments under inert atmosphere. <p>Learning Objectives</p> <ul style="list-style-type: none"> definitions, advantage and disadvantages compared to other catalytic methods. Reaction mechanisms and experimental setups for homogeneous catalysis. | | | |
| Content | | | |
| <ul style="list-style-type: none"> overview catalytic methods organometal-chemistry and transition metal catalysis organocatalysis stereoselective reactions Photocatalysis | | | |

| Material |
|---|
| lecture notes available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• specific literature for each chapter• E. Breitmaier, G. Jung: Organic Chemistry, Thieme, 7.Auflage, 2012 |

| Module name | | Techno-economic Analysis and Simulation | |
|---|--------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF43 | TechnoEco | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Völkl | Prof. Dr. Völkl | 50% Lecture, 25% Exercises, 25% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 30 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| basic knowledge in chemistry, chemical engineering and (process) modelling | | | |
| Intended learning objectives | | | |
| <p>Specific Goals</p> <p>Students should get in-depth knowledge of the conduction of techno-economic evaluations supported by process simulation</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Understanding how to carry out Techno-Economic Analysis • Comparing different process routes based on Techno-Economic criteria • Understanding how to obtain all required data • Deepening the understanding in the application of Simulation for process development and process evaluation | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Fundamentals of economical process assessment: How to calculate CAPEX and OPEX and use those values to derive corresponding criteria• Comparison of different cost estimation approaches• Application of evaluation methods for sustainability criteria, e.g. greenhouse gas emissions• Overview of methods of conceptual process design• Comparison of different approaches for a Techno-Economic evaluation of process routes• The theoretical background of the content of the module is applied in exercises and computer courses throughout the semester |
| Material |
| lecture notes available as download files |
| Recommended literature |
| <ul style="list-style-type: none">• specific literature for each chapter |

| Module name | | Microscopy – methods and applications in materials science | |
|---|---------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MF45 | MicMat | ING M1-3 | 3 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Müller | Prof. Dr. M. Müller | 50% Lecture, 50% Lab | 2 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 90 h | 15 h | 30 h | 10 h |
| + Lab course | + Exam preparation | | |
| 15 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Technical elective course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Introductory Physics course Introductory Materials Engineering course | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Students will consider different microscopy methods for the characterization of materials and components. The course is intended to provide the necessary knowledge to understand the working principle of selected different microscope types, in particular the formation of the respective image and the associated additional analysis options for materials.</p> <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Describe the interaction between an electron beam and matter, which signals are generated and how these can be used to analyze materials and components. • Describe, how different probes interact with surfaces, what forces are involved and what possibilities exist for characterizing materials | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Electron microscopy (SEM, TEM, et al.)• Scanning probe microscopy (SPM, AFM, different modes)• Sample preparation |
| Material |
| Lecture notes |
| Recommended literature |
| <ul style="list-style-type: none">• B. Voigtländer: Atomic Force Microscopy, Springer, 2019• J.I.Goldstein, et al.: Scanning Electron Microscopy and X-Ray Microanalysis, Springer, 4th Edition, 2018• J. Bauch, R. Rosenkranz: Physikalische Werkstoffdiagnostik, Springer, 2017• application notes, www.bruker.com, www.oxford.com |

| Module name | | Advanced Control Systems | |
|---|---------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV01 | ACS | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F.A. King | Prof. Dr. F.A. King | 60% Lecture, 20% Exercises, 20% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 50 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 20 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Classical control theory in frequency domain. • Vector and matrix fundamentals. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <ul style="list-style-type: none"> • Enable students to design modern control systems • Analyse state-space systems and design controllers/observers by use of numeric tools <p>Learning Objectives</p> <ul style="list-style-type: none"> • Apply state-space descriptions to control systems • Analyse a system's stability, controllability and observability • Design state space controllers and state observers by pole placement and optimal control • State-space system analysis and controller/observerdesign using Matlab | | | |

| Content |
|--|
| <p>State Space Control:</p> <ul style="list-style-type: none">• State space description, solutions for the state-space equations, analysis of state-space description (stability, controllability, observability).• State-space controller design, controller structure, computation of the pre-filter, computation of the controller matrix using pole placement and optimal control.• State observer structure and design. |
| Material |
| Lecture notes, worksheets and lab-class problem descriptions available as PDF download files |
| Recommended literature |
| <ul style="list-style-type: none">• R. C. Dorf, R. H. Bishop: Modern Control Systems, Pearson, 14. Auflage, 2021• G. F. Franklin, J. D. Powell, A. Emani-Naeini: Feedback Control of Dynamic Systems, Pearson, 8. Auflage, 2019• K. Ogata: Modern Control Engineering, Pearson, 5. Auflage, 2009 |

| Module name | | Industrial Process Control | |
|---|--|----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV02 | IPC | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. K. Krämer | Prof. Dr. K. Krämer, Prof. Dr. F. Perschl | 70% Lecture, 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 45 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 15 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> Basics of sensor applications in automation technology. Knowledge of electrical / pneumatic drives and actuators. Experience in designing logic and sequential controllers. Basics of safety rules and safety devices in industrial automation. | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <ul style="list-style-type: none"> To enable students to design and implement solutions in industrial automation. Give insight into fundamentals and specific knowledge in CNC-machinery and CNC-programming as well as in designing logical and sequential control Give an overview about higher-level industrial process control components <p>Learning Objectives</p> <ul style="list-style-type: none"> Evaluate different devices and methods with focus on the different technical parts, Develop CNC-control programs as well as more complex PLC programs Analyse and structurize CNC and PLC systems, select the right system(s) for the planned surrounding Calculate the costs of installation and maintenance of automation plants | | | |

| Content |
|---|
| <p>Part II (Perschl):</p> <ul style="list-style-type: none">• Structure and operation of a PLC system (SIMATIC S7).• Hardware configuration. Overview of programming languages.• Programming sequential control functions.• Industrial communication.• Edge and cloud computing.• Data exchange over heterogenous networks.• Industrial Internet of Things (IIoT). |
| Material |
| <p>Lecture notes, worksheets and lab course descriptions available as download files. Videos, PPT-presentations, PC-simulations.</p> |
| Recommended literature |
| <ul style="list-style-type: none">• Siemens Industry Automation Translation Services: Dictionary of Electrical Engineering, Power Engineering and Automation, Publicis MCD / Siemens, 5th edition, 2003• D. Schmid: FESTO didactic: Dictionary of Control Technology Automatisierungstechnik mit Informatik und Telekommunikation, EUROPA Lehrmittel, 5. Auflage, 2002• H. Berger: Automating with SIMATIC, Publicis MCD / Siemens, 6. Auflage, 2016• W. Kriesel, O. W. Madelung: The AS-Interface for Automation, Hanser, 2. Auflage, 1999• Phoenix Contact: Industrial Communication, PPT Presentation1, Chapt 1-7• R. Isermann: Mechatronische Systeme, Springer, 2. Auflage, 2007• T. Marlin: Process Control: Designing processes and control systems for dynamic performance, Mac Graw Hill, 2. Auflage, 2000• J. Daxl, G. Kurz, W. Schachinger: Grundlagen über numerisch gesteuerte Werkzeugmaschinen (CNC), Jugend & Volk, 2. Auflage, 2004• H. B. Kief, H. A. Roschiwal: CNC-Handbuch 2009/2010, Hanser, 2009• S. Suk-Hwan: Theory and Design of CNC Systems, Springer, 2008• P. Smid: CNC Programming Handbook, Industrial Press, 3. edition, 2007 |

| Module name | | Servo Drive Systems | |
|---|--------------------|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV03 | SDS | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. R. Hagl | Prof. Dr. R. Hagl | 75% Lecture and Exercises, 25% Lab Course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 45 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 15 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Basic knowledge in electrical drives, • closed loop control, • MATLAB/ Simulink | | | |

| Intended learning objectives |
|--|
| <p>Specific Goals:</p> <ul style="list-style-type: none"> • Enable students to design and commission motion control systems with electromechanical and direct driven servo drives. • Optimization of motion profile, controller parameters regarding reference and disturbance behavior, and contouring behavior. <p>Learning Objectives</p> <ul style="list-style-type: none"> • Knowledge of static and dynamical behavior of different drive components and their interaction. • Functional principles of motion controllers, including feed forward and filters. • Specific characteristics of digital motion controllers. • Optimization of parameter setting of motion controller. • Understanding of field oriented control for 3-phase AC-motors without and with field weakening. • Influence of position measuring devices. • Usage of simulation and engineering tools e.g. MATLAB and Simulink. |
| Content |
| <ul style="list-style-type: none"> • Static and dynamical requirements for servo drives. • Control structures and motion profiles. • Motion control of stiff drive systems, including influence of sampling time and processing dead time. • Simulation and engineering tools. • Motion control of elastic drive systems. • Feed forward and filters. • Practical courses for drive simulation. • Dynamical models of DC and AC drives including field oriented control. • Interaction of motor and mechanics. • Influence of axis controllers on contouring behavior. • Influence of position measuring devices. • Practical exercises with servo drive systems. |
| Material |
| <p>Script for lecture and practical course</p> |
| Recommended literature |
| <ul style="list-style-type: none"> • A. Binder: Elektrische Maschinen und Antriebe, Springer, 2012 • R. Fischer: Elektrische Maschinen, Carl Hanser, 17.Auflage, 2017 • J. Pollefliet: Electronic Power Control, Volume 2: Electronic Motor Control, Academia Press, 2011 • D. Schröder: Elektrische Antriebe – Grundlagen, Springer, 5.Auflage, 2013 |

| Module name | | Automation Systems | |
|---|------------------------|----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV04 | AutoSys | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. C. Meierlohr | Prof. Dr. C. Meierlohr | 60% Lecture, 40% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 40 h | 40 h | 20 h |
| + Lab course | + Exam preparation | | |
| 20 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> Fundamental knowledge on automation of manufacturing processes, basic knowledge on industrial robots | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>To enable students to design and apply state-of-the-art automation systems for industrial manufacturing systems.</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> Know details on the design and the planning procedures for automated manufacturing systems Apply safety aspects and doing a risk-analysis according to legal standards, e.g. ISO 12100 Model and operate automated manufacturing systems using simulation methods Planning the commissioning of automated manufacturing systems Analyzing data from operating the system and find possibilities to optimize the performance | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Flexible automation, planning procedures• Safety regulations and equipment• Interlinking, buffers, workpiece carriers• Process simulation for design and optimization• Commissioning and operating of automated systems, process capability and OEE• Big data: using data science for optimizing the performance |
| Material |
| Lecture notes and lab-class problem descriptions |
| Recommended literature |
| <ul style="list-style-type: none">• Lecture Notes• E. Dietrich: Abnahme von Fertigungseinrichtungen, Hanser, 4. Auflage, 2019• M. Flocke: Steigerung der Anlagenproduktivität durch OEE-Management – Definitionen, Vorgehen und Methoden – von manuell bis Industrie 4.0, Springer, 2018• S. Hesse: Grundlagen der Handhabungstechnik, Hanser, 6. Auflage, 2024• Pilz: The Safety Compendium – For the application of functional safety standards, Pilz GmbH & Co. KG, 2017• G. Reinhart: Industrieroboter – Planung, Integration, Trends : ein Leitfaden für die KMU, Vogel, 2018 |

| Module name | | Reliability of Mechatronic Systems | |
|--|---------------------|------------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV05 | Reliab | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Versen | Prof. Dr. M. Versen | 70% Lecture, 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Statistics | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>To enable students to evaluate mechatronic systems under the aspects of reliability</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Know different failure models • Apply virtual qualification methods based on robustness validation concept • Plan a test scenario for a give model, Setup/design reliable systems | | | |
| Content | | | |
| <ul style="list-style-type: none"> • Failure Modes, Defects & Testing of CMOS ICs, power devices, passive devices and electronic packaging, Fail Rate Models • ESD, Reliability Analysis on case studies, e.g. ESD • Test planning, Use of Redundancy and Monitors | | | |

| Material |
|---|
| Lectures notes and hardcopies and/or PDF download files for seminar class preparation |
| Recommended literature |
| <ul style="list-style-type: none">• A. Meyna, B. Pauli: Zuverlässigkeitstechnik, Hanser, 2. Auflage, 2010• J. Segura, C. F. Hawkins: CMOS Electronics, How it Works, How it Fails, IEEE Press, 2004• S. Voldman: ESD Physics and Devices, Wiley, 2004• J. Lutz: Semiconductor Power Devices, Springer, 2011• A. Birolini: Reliability Engineering Theory and Practice, Springer, 2010• J. McPherson: Reliability Physics and Engineering, Springer, 2010 |

| Module name | | Advanced Digital Communications | |
|---|-----------------------|---------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV07 | AdvDigCom | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Stichler | Prof. Dr. M. Stichler | 70% Lecture, 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Basics of system theory and digital signal processing | | | |
| Intended learning objectives | | | |
| <ul style="list-style-type: none"> • Understanding of the basics of digital communication systems; • concepts of modern digital communication systems: OFDM and CDMA. | | | |
| Content | | | |
| <p>Lecture:</p> <ul style="list-style-type: none"> • Basics of digital communication systems: Modulation, mobile communication channel, time variant multi-path propagation, demodulation, synchronization, channel estimation and equalization. • Concepts of modern mobile communication systems: OFDM, basics, synchronization, equalization. CDMA, basics, synchronization, equalization. <p>Lab Class:</p> <ul style="list-style-type: none"> • Simulation of methods and algorithms used in digital communication systems with tools like e.g. Mat-Lab | | | |

| Material |
|---|
| Lecture notes, worksheets and lab class handouts are available in hardcopy and PDF |
| Recommended literature |
| <ul style="list-style-type: none">• B. Sklar: Digital Communications, Fundamentals and Applications, Prentice Hall, 2000• J. G. Proakis: Digital Communications, McGraw Hill, 2001 |

| Module name | | Digital Signal Processing and Machine Learning | |
|--|-----------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV08 | DSP | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Stichler | Prof. Dr. M. Stichler | 70% Lecture, 30% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 30 h | 40 h |
| + Lab course | + Exam preparation | | |
| 0 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Fundamentals of system theory | | | |
| Intended learning objectives | | | |
| Advanced knowledge in applied digital signal processing with view on applications in the areas of information and communication technology as well as control technology | | | |
| Content | | | |
| <p>Lecture:</p> <ul style="list-style-type: none"> • Deterministic and stochastic signals and systems, • discrete Fourier- and Wavelet-Transformation, • LTI systems, • design and implementation of digital systems, • sample rate conversion, • multirate signal processing. <p>Lab class:</p> <ul style="list-style-type: none"> • Design, simulation (using MatLab and/or Simulink) and implementation of simple algorithms on digital signal processors (DSPs) and/or FPGAs. | | | |

| Material |
|---|
| Overhead, board, beamer |
| Recommended literature |
| <ul style="list-style-type: none">• A. Oppenheim, R. Schafer: Discrete-Time Processing, Pearson, 3. Edition, 2009• V. K. Ingle, J. G. Proakis: Digital Signal Processing using Matlab, Brooks/Cole, 2000• J.H. Chow, D. K. Frederick, N. W. Chbat: Discrete-Time Control Problems using Matlab, Brooks/Cole, 2003 |

| Module name | | Advanced FEM | |
|---|-----------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV09 | FEM II | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. S. Schinagl | Prof. Dr. S. Schinagl | 50% Lecture, 20% Exercises, 30% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | Winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 42 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 18 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Engineering Mechanics (Statics, Strength of materials, Dynamics), FEM basics | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>To enable students to evaluate structures and components with respect to their mechanical behavior and reliability.</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> Analyse nonlinear structural mechanic problems considering all kinds of nonlinearities (geometry, material, contact). Work in the field of modal based linear structure dynamical analyses. | | | |
| Content | | | |
| <ul style="list-style-type: none"> Fundamentals of numerical modeling and analysis of nonlinear structural problems. Modal based linear dynamics: Natural frequencies and mode shapes, frequency response analysis / harmonic analysis, transient analysis. | | | |

| Material |
|--|
| Lecture notes and hardcopies and/or PDF download files |
| Recommended literature |
| <ul style="list-style-type: none">• M. Paz, Y. H. Kim: Structural Dynamics, Theory and Computation, Springer, 6th edition, 2019• W. Rust: Non-Linear Finite Element Analysis in Structural Mechanics, Springer, 1st edition, 2015 |

| Module name | | Electromagnetic Compatibility | |
|--|----------------------|-------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV10 | EMC | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. N. Seliger | Prof. Dr. N. Seliger | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge in electromagnetic fields, transmission lines, electrical signals and circuit components | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Within this lecture students will learn the basics of EMC engineering and its application in early system design. By discussing case studies and lab experiments we will bridge the gap between theory and practical implementation.</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Understanding of basic aspects of EMC: theory of emission and reception of conducted and radiated electro-magnetic interference signals, coupling mechanisms and their models. Design methods and techniques for EMC compliance: PCB and circuit design, grounding, filter design, signal spectra, system design, shielding aspects. • EMC measurement techniques and EMC standards | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Introduction to EMC and EMI phenomena, Basic concepts (conducted and radiated emission and susceptibility)• Electrical signals and their spectra, Propagation and crosstalk, coupling, EMC modeling• Interference control techniques (PCB and circuit design, shielding, grounding, filter design), EMC measurements and EMC Standards, Case studies and Lab experiments |
| Material |
| Lecture notes and problem sheets |
| Recommended literature |
| <ul style="list-style-type: none">• C. Paul: Introduction to EMC, Wiley, 2006• H. Ott: EMC Engineering, Wiley, 2009• J. Franz: EMV: Störungssicherer Aufbau elektronischer Schaltungen, Springer Vieweg, 5.Auflage, 2013• C. Christopoulos: Principles and Techniques of EMC, CRC Press, 2.Auflage, 2007• M. Montrose, E. Nakauchi: Testing for EMC Compliance, Wiley, 2004• A. Schwab: Elektromagnetische Verträglichkeit, Springer, 2007• S. Dhia, M. Ramdani, E. Sicard: EMC of Integrated Circuits, Springer, 2006 |

| Module name | | Image Processing for Automated Production | |
|--|---------------------|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV11 | ImPrc | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Wagner | Prof. Dr. M. Wagner | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Familiarity with basic matrix calculations | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Students will be enabled to</p> <ul style="list-style-type: none"> • select suitable hardware components for a given imaging problem • calibrate the optical system • design, test and optimize the network of imaging operators by using a GUI imaging toolkit • create a graphical user interface • establish a complete industrial application by generating sequences for operator execution and data exchange <p>Learning Objectives</p> <p>During this course, students will gain knowledge in:</p> <ul style="list-style-type: none"> • Types of cameras, data formats, optics, illuminations • two dimensional algorithms in image enhancement, extraction and localization of features, classification of features • 2d and 3d transformations • 2d and 3d camera calibration • creation of industrial imaging applications by using a GUI (graphical user interface) imaging toolkit | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Camera types, image- and data formats, optics, illuminations, optical filters.• Binary image morphology.• Image enhancement: Noise reduction filters, grey value scaling, thresholding.• Digital Fast Fourier Transform (DFFT).• Extraction of edges and ridges.• Pattern matching.• Shape analysis.• Hough Transform and Generalized Hough Transform (GHT) for object localization.• Classifiers, especially Neural Network Classifiers.• Texture analysis.• 2d transforming of images and masks.• 2d camera calibration, internal and external camera parameters.• 3d camera calibration.• 3d object localization.• 3d line section based surveying. |
| Material |
| Lecture notes and problem sheets |
| Recommended literature |
| <ul style="list-style-type: none">• S. Theodoridis, K. Koutroumbas: Pattern Recognition, Elsevier, 2009• E. R. Davies: Machine Vision - Theory, Algorithms, Practicalities, Elsevier, 2005• C. Steger, M. Ulrich, C. Wiedemann: Machine Vision Algorithms and Applications, Wiley, 2.Auflage, 2018 |

| Module name | | Mechanical Design | |
|---|--|--------------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV12 | MecDesign | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Wagner, Prof. Dr. M. Neumaier | Prof. Dr. I. Ragai, Prof. Dr. M. Wagner | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| A minimum of 15 credits in mechanical drawing, calculation of geometric tolerances, CAD | | | |

| Intended learning objectives |
|--|
| <p>Specific Goals: The students will have a practical knowledge of and ability to develop, design and optimize technical, mainly mechanical products in a conflicted area of complex requirements. The students will have experience in project management.</p> <p>Learning Objectives Various complex design tasks are given to student teams. The teams have to plan and execute the development and design tasks independently under supervision of professors and engineers. Depending on the task, the teams use supporting tools and methods for mechanical design such as</p> <ul style="list-style-type: none"> • advanced CAD (free form surface, sheet metal design, motion assembly) • DFMA (Design for Manufacturing and Assembly) method • FEM (Finite Element Method) • creative design methodologies • industrial design basics • arithmetic and statistical tolerance calculations • project management • prototyping and testing <p>At the end, all product documents are to be submitted and a final pre-sentation is to be given in a concluding seminar meeting.</p> |
| Content |
| <ul style="list-style-type: none"> • Design methodologies • Optimizing for assembly and manufacturing • Design project management • Advanced design tools • Product documentation • Tolerance calculations |
| Material |
| <p>Literature in the library and on the internet, standards, patents, software, tools and methods (DFMA, CAD, FEM, statistical tolerance calculation)</p> |
| Recommended literature |
| <ul style="list-style-type: none"> • Pahl et. al.: Engineering Design: A Systematic Approach, Springer, 3rd edition, 2007 • VDI-Guideline 2221 |

| Module name | | Advanced light weight construction | |
|---|--------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV13 | ALC | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Riß | Prof. Dr. Riß | 60% Lecture, 20% Exercises, 20% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | Summer semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 36 h | 30 h | 30 h |
| + Lab course | + Exam preparation | | |
| 24 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| <ul style="list-style-type: none"> • Engineering Mechanics (Statics, Strength of materials, Dynamics), • FEM basics; • Manufacturing basics, • Material Science basics | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Within this lecture students will learn the basics of lightweight design topics (combination of structural lightweight design, manufacturing lightweight design and material lightweight design) and getting to know how to apply this.</p> <p>Learning Objectives</p> <ul style="list-style-type: none"> • Understanding the basic effect of lightweight design: lightweight design approaches, assessment and selection of lightweight designs, methods and rules for lightweight design parts, standard elements for lightweight design (shell, lattice, honeycomb,...) • Learning the basics of manufacturing for lightweight design: manufacturing technologies, limits • Understanding the basics of lightweight materials: kind of material, selection of material, pros and cons | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Introduction in the topic of lightweight design, terminology, basic mechanical engineering topics for lightweight design, lightweight design approaches (for example: topology optimization),• manufacturing technology dedicated to lightweight design,• materials for lightweight design,• analysis and calculation of lightweight design parts,• bionic design,• lightweight design standards,• lessons learnt from practical application,• case studies and lab exercises |
| Material |
| Lecture notes and hardcopies and/or PDF download files |
| Recommended literature |
| <ul style="list-style-type: none">• H.-P. Degischer, S. Lüftl: Leichtbau - Prinzipien, Werkstoffauswahl und Fertigungsvarianten, Wiley, 2009• L. J. Gibson, M. F. Ashby: Cellular solids, Cambridge University Press, 2st ed.,1997• B. Klein: Leichtbau-Konstruktion - Berechnungsgrundlagen und Gestaltung, Vieweg + Teubner, 8. Aufl.,2009• C. Mattheck: Design in der Natur, Rombach, 4. Aufl.,2006• C. Mattheck: Verborgene Galtsgesetze der Natur, Karlsruher Institut für Technologie, 2006• W. Nachtigall: Bau-Bionik - Natur, Analogien, Technik, Springer, 2003• J. Wiedemann: Leichtbau, Springer, 3. Aufl.,2007 |

| Module name | | Advanced injection molding | |
|--|--------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV14 | AdvInjMold | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. M. Würtele | Prof. M. Würtele | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | German |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 30 h | 30 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Bachelor course injection molding | | | |
| Intended learning objectives | | | |
| Learning of Machine and processing technology for standard injection molding and also for special processes and learning to project injection molding plants | | | |
| Content | | | |
| <ul style="list-style-type: none"> • Materials for injection molding, Injection molding Machines, Injection molding processing • Calculations for projecting • Special process technologies | | | |

| Module name | | Selected topics of Polymer Chemistry and Materials Sciences | |
|--|----------------------------------|---|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV15 | PolChMatSc | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. D. Muscat | Prof. Dr. D. Muscat / Dr. Schmid | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| none | | | |
| Intended learning objectives | | | |
| <p>Part I The first part introduces the different types of caoutchoucs and their nomenclature. Typical examples are explained. The vulcanization of caoutchoucs and the production of tires as the major example in the rubber field are discussed. Besides classical rubbers new polymer networks based on pericyclic reactions are introduced. Therefore, first the Diels Alder reaction is explained and then the use of this reaction in polymeric networks is reagarded. For a better understanding of the analysis of plastics an overview of applied techniques is given and some examples are discussed in detail.</p> <p>Part II Understanding the reactions of organic Peroxides as radikcal sources. Including safe handling with organic peroxides. Application of organ. peroxides for the modification of polymers. Explanation of the radical reactions for crosslinking, grafting and curing, as well as for the PP-degradation. This from an application-technical point of view.</p> | | | |

| Content |
|--|
| <p>Part I : Caoutchoucs, Plastics, Reaction-mechanisms Understanding</p> <ol style="list-style-type: none">1) types and production of caoutchoucs, vulcanization and production of rubbers2) novell networks based on pericyclic reactions (Diels Alder reactions)3) analysis of Plastics <p>Part II : Peroxide modification of polymers</p> <ol style="list-style-type: none">1) Radikal initators – Use and reactions (Organic peroxides)2) Safe handling of organic peroxides3) Crosslinking of polyolefines and elastomers4) Vis breaking of polymers (i. e. PP degradation)5) Monomer grafting onto polymers6) Curing of unsaturated polyesters |
| Recommended literature |
| <ul style="list-style-type: none">• H.G.Elias: Makromoleküle Band 1:Chemische Struktur und Synthesen, Wiley-VCH, 6.Auflage, 1999• H.G.Elias: Makromoleküle Band 2:Physikalische Strukturen und Eigenschaften, Wiley-VCH, 6.Auflage, 2000• J. Lahann: Click Chemistry for Biotechnology and Materials Science, Wiley, 2009• E. Baur, S. Brinkmann,T. Osswald, N. Rudolph, and E. Schmachtenberg: Saechtling Kunststoff Taschenbuch, Hanser, 31. Aufl.,2013• W. Hellerich, G. Harsch, E. Baur: Werkstoff-Führer Kunststoffe Eigenschaften - Prüfungen – Kennwerte, Hanser, 10. Auflage,2010 |

| Module name | | Freeform-Surfaces | |
|---|--------------------|-----------------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV16 | FreeFS | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Lazar | Prof. Dr. M. Lazar | 50% Lecture, 50% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 60 h | 15 h | h |
| + Lab course | + Exam preparation | | |
| 60 h | 15 h | | |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| Knowledge of mathematical fundamentals 3D-CAD | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Goals Knowledge of principles in the development of products with freeform surfaces Learning Objectives</p> <ul style="list-style-type: none"> • Mathematic background of curves and surfaces • Methods of designing freely shaped objects • Methods of manufacturing freely shaped objects • Inspection of freely shaped objects <p>Learning Objectives</p> <ul style="list-style-type: none"> • Mathematic background of curves and surfaces • Methods of designing freely shaped objects • Methods of manufacturing freely shaped objects Inspection of freely shaped objects | | | |

| Content |
|---|
| <ul style="list-style-type: none">• Mathematical Background (Bezier Curves, B-Splines, NURBS)• CAGD: Introduction to shape design with CATIA• Scanning Technologies, Reverse Engineering, CAD-CAM and 5-axes Machining, Rapid Prototyping |
| Material |
| Lecture notes, Software: CATIA, CAMWorks, Colin3D |
| Recommended literature |
| <ul style="list-style-type: none">• L. Piegl, W. Tiller: The NURBS Book, Springer, 1997• G. Farin, J. Hoschek, M.-S. Kim: Handbook of Computer Aided Geometric Design, Elsevier, 2002 |

| Module name | | Mechanical Transmission | |
|--|---------------------|-----------------------------|--------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV17 | MecTransm | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. Doleschel | Prof. Dr. Doleschel | 80% Lecture , 20% Exercises | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer Semester | Englisch |
| Total workload | = Presence | + Self-study | + Exam preparation |
| 150 h | 80 h | 20 h | 40 h |
| Applicability of the module in the degree programmes | | | |
| Specialization subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| basic course in mechanical design | | | |
| Intended learning objectives | | | |
| Specific Goals: <ul style="list-style-type: none"> • design capability on typical gear box types (spur gears, worm gears, bevel gears), on lubrication • calculation methods | | | |
| Content | | | |
| <ul style="list-style-type: none"> • Gear design • Gear failure analysis • Analysis of industrial and automotive systems | | | |
| Material | | | |
| Lecture notes | | | |
| Recommended literature | | | |
| <ul style="list-style-type: none"> • S. Radzevich: Dudley's Handbook of practical gear design and manufacture, CRC Press, 3. Edition 2016 | | | |

| Module name | | Geometric Dimensioning and Tolerancing | |
|--|--------------------|--|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MV18 | GD&T | ING M1-3 | 5 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. M. Lazar | Prof. Dr. M. Lazar | 67% Lecture, 33% Lab course | 4 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 150 h | 45 h | 45 h | h |
| + Lab course | + Exam preparation | | |
| 40 h | 20 h | | |
| Applicability of the module in the degree programmes | | | |
| Semi-mandatory course in ENG-Master | | | |
| Recommended prerequisites | | | |
| Engineering drawing | | | |
| Intended learning objectives | | | |
| <p>Specific Goals:</p> <p>Interpretation of technical drawings</p> <p>Ability to assess geometric product specifications</p> <p>Ability to create unambiguous geometric product specifications</p> <p>Learning Objectives:</p> <ul style="list-style-type: none"> • Knowledge about principles of geometric tolerancing • Understanding the structure of the ISO GPS-System • Knowledge of the ISO GPS terminology • Ability to establish appropriate processes to verify geometric specifications | | | |

| Content |
|--|
| <ul style="list-style-type: none">• Basic Rules of the ISO GPS System• Principle Procedures in Metrology• Coordinate Measuring Technique• Tolerances of Size• Tolerances of Form• Datum Systems• Tolerances of Orientation, Location and Run-Out• Tolerances of Profile• Envelope Principle vs. Independency• Maximum and Least Material Requirement• Comparison of ISO-GPS to ASME Y14.5 |
| Material |
| Lecture notes, Software: Zeiss Quality Suite, PC-DMIS |
| Recommended literature |
| <ul style="list-style-type: none">• S. Tornincasa: Technical Drawing for Product Design; Mastering ISO GPS and ASME GD&T, Springer, 2021• ISO: ISO 286 Geometrical product specifications – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits, International Organization for Standardization, 2010 / Corr. 2013• ISO: ISO 1101 Geometrical product specifications – Geometrical tolerancing – Tolerances of form, orientation, location and run-out, International Organization for Standardization, 2017• ISO: ISO 1660 Geometrical product specifications (GPS) – Geometrical tolerancing – Profile tolerancing, International Organization for Standardization, 2017• ISO: ISO 2692 Geometrical product specifications – Geometrical tolerancing – Maximum-Material-requirement (MMR), Least-Material- requirement (LMR), Reciprocity requirement(RPR), International Organization for Standardization, 2015 / DIS 2019• ISO: ISO 14405-1 Geometrical product specifications – Dimensional tolerancing – Part 1: Linear sizes, International Organization for Standardization, 2016 |

| Module name | | Master's project | |
|---|----------------------|----------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MP01 | - | ING M1-3 | 12 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Perschl | Professor as advisor | 100 % Lab course | 10 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter & summer term | English |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 360 h | 0 h | 0 h | h |
| + Lab course | + Exam preparation | | |
| 360 h | 0 h | | |
| Applicability of the module in the degree programmes | | | |
| Mandatory subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| none, but some projects require competences from specialization modules | | | |
| Intended learning objectives | | | |
| To learn to apply project management methods and to train team working skills; in a close-to-real-life situation students shall experience what it means to systematically analyze and plan a project, to organize themselves and to cooperate in a team and to deliver results within the planned deadline. | | | |
| Content | | | |
| <ul style="list-style-type: none"> • Case study project that typically deals with a real-world problem assigned by industry or proposed by professors; project is carried out by a team of 4-6 students and coached by one or two professors. • The project has to be carried out in the laboratories of the university | | | |
| Material | | | |
| project related | | | |
| Recommended literature | | | |
| <ul style="list-style-type: none"> • project related | | | |

| Module name | | Master Thesis | |
|--|--------------------------|----------------------|------------------------|
| Number(s) | Abbreviation | Curriculum semester | ECTS |
| MP02 | - | ING M1-3 | 25 |
| Responsible for the module | Lecturer(s) | Teaching form | SWS |
| Prof. Dr. F. Perschl | 2 professors as advisors | 100 % Lab course | 24 |
| Form of examination | Module duration | Module rotation | Language |
| See SPO | 1 Semester | winter & summer term | English/German |
| Total workload | = Presence | + Self-study | + Exercise preparation |
| 750 h | 0 h | 0 h | h |
| + Lab course | + Exam preparation | | |
| 720 h | 30 h | | |
| Applicability of the module in the degree programmes | | | |
| Mandatory subject in ENG-Master | | | |
| Recommended prerequisites | | | |
| none | | | |
| Intended learning objectives | | | |
| Final project at an engineer's qualification level; carried out by an individual student on his/her own with two professors as advisors either at Rosenheim University of Applied Sciences or at an industrial company | | | |
| Content | | | |
| Depending on student's selection and availability | | | |
| Material | | | |
| project related | | | |
| Recommended literature | | | |
| <ul style="list-style-type: none"> • project related | | | |

