B.Sc. Mechatronics (PO 2014)

Module handbook
FB 18
Date: 19.07.2022

TECHNISCHE UNIVERSITÄT DARMSTADT

FB 18

Module handbook: B.Sc. Mechatronics (PO 2014)

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Email: servicezentrum@etit.tu-darmstadt.de

Contents

1 Fundamentals of Electrical Engineering and Information Technology 1
Introductionary Project . . . 1
Electrical Engineering and Information Technology I . . . 2
Electrical Engineering and Information Technology Lab I . . . 4
Electrical Engineering and Information Technology II . . . 6
Deterministic Signals and Systems . . . 8

2 Fundamentals of Mathematics 10
Mathematics I (Electrical Engineering) . . . 10
Mathematics II (Electrical Engineering) . . . 11
Mathematics III (Electrical Engineering) . . . 12
Numerical and Statistical Methods . . . 13

3 Fundamentals of Engineering Mechanics 14
Engineering Mechanics I (Statics) . . . 14
Engineering Mechanics II (Elastostatics) . . . 16
Engineering Mechanics III (Dynamics) . . . 17

4 More Fundamentals 19
Materials Technology for Mechatronics . . . 19
General Computer Science I . . . 20
Computer Aided Design (CAD) . . . 21
Technical Thermodynamics I . . . 23
Electronics . . . 25
Programming in Automatic Control (C/C++) . . . 27
Fluid Mechanics for Mechatronics . . . 28
Measuring Technique . . . 29
Logic Design . . . 31
Electrical Machines and Drives . . . 32
Mechanical Components and System Behaviour for Mechatronics . . . 34
System Dynamics and Automatic Control Systems I . . . 35
Laboratory Course Control of Mechatronic Systems . . . 37
Actuators for Mechatronic Systems Laboratory . . . 38

5 Optional Modules 39
5.1 Optional Catalog ETiT: Electrical Engineering and Information Technology . . . 39
Electrical Power Engineering . . . 39
Introduction to Electrodynamics . . . 41
Fundamentals of Signal Processing . . . 42
Communication Technology I . . . 44
Power Electronics . . . 46
Fundamentals of Communication . . . 48
Computer Systems I . . . 50
Electronics Lab . . . 52
General Computer Science II . . . 53
Mechatronics Workshop . . . 55
Laboratory Matlab/Simulink I . . . 56

Microelectronic Devices 57
Modelling and simulation of circuits 59
5.2 Optional Catalog MB: Mechanical Engineering 61
Design of Human-Machine-Interfaces 61
Fundamentals of Turbomachinery and Fluid Systems 63
Motor Vehicles 65
Fundamental Fluid Mechanics 67
Technical Thermodynamics II 68
Production Technology 70
Combustion Engines I 71
Machine Tools and Industrial Robots 73

1 Fundamentals of Electrical Engineering and Information Technology

Module name Introductionary Project					
Module nr. 18-de-1010	**Credit points** 2 CP	**Workload** 60 h	**Self study** 30 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Harald Klingbeil		

1	**Teaching content** Based on a complex technical problem students will get to know an idea of the diversity of electrical and information enginering. The introductionary project gives a perspective of the upcoming course of studies. It gives an introduction in engineering thinking and working. Groups of students will work in teams for one complete week. Each group of students will be accompanied by a team- and a technical tutor.
2	**Learning objectives** Students get to know problem analysis, information acquisition, team work, project management, and presentation of results.
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Study achievement, Oral examination, Duration: 15 Min., p/np RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Study achievement, Oral examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc MEC, BSc iST
8	**Grade bonus compliant to §25 (2)**
9	**References** lecture notes (will be handed out)

Courses

Course Nr. 18-de-1010-pj	**Course name** Introductionary Project (Project Week)	
Instructor Prof. Dr.-Ing. Harald Klingbeil, M. A. Stephanie Bockshorn, Dipl.-Soz. Goran Beil	**Type** Project	**SWS** 2

Module name Electrical Engineering and Information Technology I					
Module nr. 18-hs-1070	**Credit points** 7 CP	**Workload** 210 h	**Self study** 135 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Jutta Hanson		

1 Teaching content

Units and Equations: Unit systems, equation writing.
Basic definitions: Charge, current, voltage, resistance, energy and power.
Currents and voltages in electrical circuits: Ohmic law, node and mesh equations, parallel and series connections, current and voltage measurement, linear and nonlinear elements, superposition method, star-delta-transformation, node and mesh analysis in linear circuits, controlled sources.
AC systems: Time-dependent currents and voltages, steady-state mode sinusoidal currents and voltages in linear RLC-circuits, phasor diagrams, resonances in RLC circuits, AC power, locus diagrams, two-port networks, transformer, polyphase systems.

2 Learning objectives

After successful completion of the module students are able:

- to utilize the basic equations in electrical engineering,
- to determine the currents and voltages in linear and nonlinear circuits,
- to analyze DC and AC systems,
- to calculate simple filter and resonant circuits,
- to apply the complex calculation in electrical AC systems.

3 Recommended prerequisites for participation

4 Form of examination

Module exam:

- Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Examination, Weighting: 100 %)

7 Usability of the module

BSc. ETiT, BSc iST, BSc MEC, BSc. Wi-ETiT, BSc CE, LA Physik/Mathematik

8 Grade bonus compliant to §25 (2)

9 References

- Frohne, H. u.a. Moeller Grundlagen der Elektrotechnik
- Clausert, H. u.a. Grundgebiete der Elektrotechnik 1 + 2

Courses

	Course Nr. 18-hs-1070-vl	**Course name** Electrical Engineering and Information Technology I		
	Instructor Prof. Dr.-Ing. Jutta Hanson		**Type** Lecture	**SWS** 3
	Course Nr. 18-hs-1070-ue	**Course name** Electrical Engineering and Information Technology I		
	Instructor Prof. Dr.-Ing. Jutta Hanson, M.Sc. Rafael Steppan, M.Sc. Achraf Kharrat		**Type** Practice	**SWS** 2

Module name Electrical Engineering and Information Technology Lab I					
Module nr. 18-kn-1040	**Credit points** 4 CP	**Workload** 120 h	**Self study** 60 h	**Module duration** 2 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr. Mario Kupnik		

1 Teaching content

After a safety instruction for electrical equipment, students dolab experiments covering foundations of electrical engineering by using theoretical and experimental instructions to improve basic electrical understanding. Building up a test set autonomously and performing of measurements and evaluations in the form of logs to confirm the theoretical knowledge and lead to independent work in practice.
The following experiments are performed:

- Investigate real behavior of ohmic resistors
- Investigate real behavior of capacitors and inductors
- Calculate impedances of basic two-terminal circuits using network theory
- Measure of electrical power in AC circuits and investigate in the real behaviour of transformers
- DC technology, capacity and inductors, AC technology - Impedances and two-terminal circuits, transformer & power;

2 Learning objectives

After preparing the afternoons independently and self-implementing the measurement setup and measurement tasks by active participation in the practical group and by thorough preparation of the associated measurement protocols, you should be able to:

1. Perform the measurement of basic electrical parameters of DC and AC circuits, independently and in compliance with safety rules
2. measuring the frequency response of passive electrical networks and resonant circuits, and electric power measurement
3. the measurement of circuits for the determination of magnetic, electro-thermal and high-frequency. You have to be able to build and run your own measurements
4. interpretations of the measurement results in terms of its technical meaning, but also their accuracy and error sources safely.

3 Recommended prerequisites for participation

Parallel attending the lectures and exercises, "Electrical Engineering I and II"

4 Form of examination

Module exam:

- Module exam (Study achievement, Optional, Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Study achievement, Optional, Weighting: 100 %)

7 Usability of the module

BSc ETiT

8 Grade bonus compliant to §25 (2)

9	**References** detailed script with instructions for the experiments; Clausert, H. / Wiesemann, G.: Grundgebiete der Elektrotechnik, Oldenbourg,1999			
Courses				
	Course Nr. 18-kn-1040-pr	**Course name** Electrical Engineering and Information Technology Lab I A		
	Instructor Prof. Dr. Mario Kupnik		**Type** Internship	**SWS** 2
	Course Nr. 18-kn-1041-pr	**Course name** Electrical Engineering and Information Technology Lab I B		
	Instructor Prof. Dr. Mario Kupnik		**Type** Internship	**SWS** 2
	Course Nr. 18-kn-1040-tt	**Course name** Electrical Engineering and Information Technology I, Safety instructions and rules		
	Instructor Prof. Dr. Mario Kupnik		**Type** Tutorial	**SWS** 0

Module name Electrical Engineering and Information Technology II					
Module nr. 18-gt-1020	**Credit points** 7 CP	**Workload** 210 h	**Self study** 135 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Gerd Griepentrog		

1	**Teaching content** Electrostatic fields; stationary electrical flow fields; stationary magnetic fields; temporally variable magnetic fields; capacitor networks, transmission lines
2	**Learning objectives** The students have detached themselves from the conception that all electrical procedures are line- bound; they have a clear idea of the field term, can read and interpret field plots and also design simple field plots themselves; they understand the difference between a curl and a divergence field, can describe this difference mathematically and are able to recognize the field type from a mathematical description, respectively; they are able to calculate field distributions for simple rotationally symmetric arrangements analytically; they can deal surely with the definitions of the electrostatic, the electrical quasi-static, the magnetostatic and the magneto-electric field; they have recognized the connection and dualism of electricity and magnetism; they control the mathematical apparatus necessary for their description and can apply it to simple examples; they can calculate with nonlinear magnetic circuits; they can compute inductance, capacity and resistance of simple geometrical arrangements and understand them now as physical characteristics of the respective arrangement; they have recognized, how different forms of energy can be transferred into each other and are thereby already able to solve simple scientific engineering problems; they have understood the underlying physical backgrounds for many applications of electrical engineering and are able to describe them mathematically, develop it further in a simple way and apply it to other examples; they are familiar with the system of Maxwell's equations and can transfer them from the integral into the differential form; they have a first idea of the importance of Maxwell's equations for all conceptual formulations of electrical engineering and they understand the propagation of electromagnetic waves in the free space and on transmission lines
3	**Recommended prerequisites for participation** Electrical Engineering and Information Technology I
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc MEC, BSc Wi-ETiT, LA Physik/Mathematik, BSc CE, BSc iST
8	**Grade bonus compliant to §25 (2)** Notenverbesserung entsprechend 25 (2) APB TU Darmstadt
9	**References**

- Downloadable slides
- Clausert, Wiesemann, Hinrichsen, Stenzel: „Grundgebiete der Elektrotechnik I und II“; ISBN 978-3-486-59719-6
- Prechtl, A.: „Vorlesungen über die Grundlagen der Elektrotechnik - Band 2“ ISBN: 978-3-211-72455-2

Courses

Course Nr.	**Course name**		
18-gt-1020-vl	Electrical Engineering and Information Technology II		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Gerd Griepentrog		Lecture	3
Course Nr.	**Course name**		
18-gt-1020-ue	Electrical Engineering and Information Technology II		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Gerd Griepentrog, M.Sc. Daniel Großmann		Practice	2

Module name Deterministic Signals and Systems					
Module nr. 18-kl-1010	**Credit points** 7 CP	**Workload** 210 h	**Self study** 135 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Anja Klein		

1	**Teaching content** Fourier Series: Motivation; Fourier series with real coefficients; Fourier series with complex coefficients;examples and applications Fourier Transform: Motivation - Derviation from Fourier series - Dirichlet conditions - delta function - step function - properties of F-transform - special cases - examples and applications - transmissions systems- expansion into partial fractions Convolution: Time invariant systems - convolution in frequency domain- Parseval's theorem - properties-examples and applications Systems and Signals: Bandlimited and time limited systems - systems with only one energy store - examples and applications Laplace Transform: Motivation - single sided L-transform - inverse L-transform - theorems of L- transform - examples and applications Linear differential equations: Time invariant systems - rules - general differentiation - linear passive electrical networks - equivalent circuits for passive electrical elements - examples and applications z-Transform: motivation - sampling - numerical order - definition - examples - transfer function - sampling theorem - examples and applications Discrete Fourier Transform: motivation, derivation sampling, examples and applications
2	**Learning objectives** The student should understand the principles of integral transformations. He should apply them for the solution of physical problems. The techniques of this lecture are essential tools which will be needed in many follow-up lectures and exercises.
3	**Recommended prerequisites for participation** Elektrotechnik und Informationstechnik I und Elektrotechnik und Informationstechnik II
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc MEC, BSc Wi-ETiT, LA Physik/Mathematik, BSc CE, BSc iST
8	**Grade bonus compliant to §25 (2)**
9	**References**

A script of the lecture or slides respectively, will be provided in electronic form.
Basic Literature:
Wolfgang Preuss, "Funktionaltransformationen", Carl Hanser Verlag, 2002; Klaus-Eberhard Krueger "Transformationen", Vieweg Verlag, 2002;
H. Clausert, G. Wiesemann "Grundgebiete der Elektrotechnik 2", Oldenbourg, 1993; Otto Föllinger "Laplace-, Fourier- und z-Transformation", Hüthig, 2003;
T. Frey, M. Bossert, Signal- und Systemtheorie, Teubner Verlag, 2004
Further Literature:
Dieter Mueller-Wichards "Transformationen und Signale", Teubner Verlag, 1999
Exercises:
Hwei Hsu "Signals and Systems", Schaum's Outlines, 1995

Courses

Course Nr.	**Course name**		
18-kl-1010-vl	Deterministic Signals and Systems		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Anja Klein, Prof. Dr.-Ing. Marius Pesavento		Lecture	3
Course Nr.	**Course name**		
18-kl-1010-ue	Deterministic Signals and Systems		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Anja Klein, Prof. Dr.-Ing. Marius Pesavento, M.Sc. Maximilian Wirth		Practice	2

2 Fundamentals of Mathematics

Module name Mathematics I (Electrical Engineering)					
Module nr. 04-00-0108	**Credit points** 8 CP	**Workload** 240 h	**Self study** 150 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Apl. Prof. Dr. rer. nat. Steffen Roch		

1	**Teaching content** Basics, real and complex numbers, real funktions, continuity, differential and integral calculus in one variable, vector spaces, linear mappings, systems of linear equations
2	**Learning objectives**
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Oral/written examination, Default RS) Usually the exam is taken in form of a written test (90 min), except when there are only a small number of potential participants. In this case, the exam can be taken in the form of an oral exam (30 min). The decision about the form of the exam is taken and communicated during the first two weeks of the lecture, based on the prospective number of students taking the exam.
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)
7	**Usability of the module** Für B.Sc.ETiT, B.Ed.ETiT, B.Sc.WIETiT, B. Sc. Mec, B. Sc. CE, B. Sc. IST, B. Sc. MedTech
8	**Grade bonus compliant to §25 (2)**
9	**References**

Courses

Course Nr. 04-00-0126-vu	**Course name** Mathematics I (Electical Engineering)		
Instructor Apl. Prof. Dr. rer. nat. Steffen Roch		**Type** Lecture and practice	**SWS** 6

Module name Mathematics II (Electrical Engineering)					
Module nr. 04-00-0109	**Credit points** 8 CP	**Workload** 240 h	**Self study** 150 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Apl. Prof. Dr. rer. nat. Steffen Roch		

1	**Teaching content** Determinants, eigenvalues, quadratic forms, sequences and series of functions, Taylor and Fourier series, differentiala calculus in R^n, extrema, inverse and implicit functions, path integrals, integration in R^n
2	**Learning objectives**
3	**Recommended prerequisites for participation** Recommended: Mathematik I (für ET)
4	**Form of examination** Module exam: • Module exam (Technical examination, Oral/written examination, Default RS) Usually the exam is taken in form of a written test (90 min), except when there are only a small number of potential participants. In this case, the exam can be taken in the form of an oral exam (30 min). The decision about the form of the exam is taken and communicated during the first two weeks of the lecture, based on the prospective number of students taking the exam.
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)
7	**Usability of the module** B.Sc.ETiT, B.Ed.ETiT, B.Sc.WIETiT, B. Sc. Mec, B. Sc. CE, B. Sc. IST, B. Sc. MedTech
8	**Grade bonus compliant to §25 (2)**
9	**References**

Courses

Course Nr.	**Course name**		
04-00-0079-vu	Mathematics II (Electrical Engineering)		
Instructor		**Type**	**SWS**
Apl. Prof. Dr. rer. nat. Steffen Roch		Lecture and practice	6

Module name
Mathematics III (Electrical Engineering)

Module nr.	Credit points	Workload	Self study	Module duration	Module cycle
04-00-0111	8 CP	240 h	150 h	1 Term	Every 2. Semester

Language	Module owner
German	Apl. Prof. Dr. rer. nat. Steffen Roch

1 Teaching content
integral calculus: surface integrals, integral theorems; ordinary differential equations: linear and non-linear differential equations, existence and uniqueness of solutions, elementary techniques, linear systems with constant coefficients, Laplace transform; Complex Analysis: complex functions, complex differentiation, Cauchy's integral formula, power series and Laurent series, residues, residue theorem

2 Learning objectives

3 Recommended prerequisites for participation
Recommended: Mathematik I und Mathematik II (für ET)

4 Form of examination
Module exam:
- Module exam (Technical examination, Oral/written examination, Default RS)

Usually the exam is taken in form of a written test (90 min), except when there are only a small number of potential participants. In this case, the exam can be taken in the form of an oral exam (30 min). The decision about the form of the exam is taken and communicated during the first two weeks of the lecture, based on the prospective number of students taking the exam.

5 Prerequisite for the award of credit points
Passing the final module examination

6 Grading
Module exam:
- Module exam (Technical examination, Oral/written examination, Weighting: 100 %)

7 Usability of the module
B.Sc.ETiT, B.Ed.ETiT, B.Sc.WIETiT, B. C. MedTech, B.Sc.MEC, B.Sc.CE, B.Sc.IST

8 Grade bonus compliant to §25 (2)

9 References

Courses

Course Nr.	Course name
04-00-0127-vu	Mathematics III (Electrical Engineering)

Instructor	Type	SWS
Apl. Prof. Dr. rer. nat. Steffen Roch	Lecture and practice	6

Module name Numerical and Statistical Methods					
Module nr. 04-00-0112	**Credit points** 8 CP	**Workload** 240 h	**Self study** 150 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Prof. Dr. rer. nat. Stefan Ulbrich		

1	**Teaching content** Numerical Analysis: linear equations, interpolation, numerical integration, systems of nonlinear equations, initial value problems for ODEs, numerical methods for eigenvalue problems Statistics: basic concepts of statistics and probability theory, regression, multivariate distributions, methods of estimation, confidence intervals, tests for normally distributed random variables, robust statistics
2	**Learning objectives**
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Oral/written examination, Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Oral/written examination, Weighting: 100 %)
7	**Usability of the module**
8	**Grade bonus compliant to §25 (2)**
9	**References**

Courses

Course Nr. 04-00-0081-vu	**Course name** Numerical and Statistical Methods		
Instructor Prof. Dr. rer. nat. Stefan Ulbrich		**Type** Lecture and practice	**SWS** 6

3 Fundamentals of Engineering Mechanics

Module name Engineering Mechanics I (Statics)					
Module nr. 16-64-5190	**Credit points** 6 CP	**Workload** 180 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Martin Oberlack		

1	**Teaching content** Definition of force, general systems of forces and equilibrium of rigid bodies, center of mass, reaction of the supports, statically determined system, trusses, beams, frames, curved beams, work principles, stability and friction.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Discern and explain the concept of force, moment, and equilibrium. 2. Analyse statically determinate problems independently, i.e. to identify the forces, and determine their attack points and effects, and formulate equilibrium conditions. 3. Ascertain the support reactions in statically determinate systems by means of equilibrium conditions or the principle of virtual work. 4. Compute internal forces and moments in beams and trusses. 5. Determine the center of gravity of a given rigid body. 6. Determine the equilibrium positions of a given movable system and investigate their stability. 7. Analyse static systems including static or kinetic frictions and calculate corresponding forces.
3	**Recommended prerequisites for participation** None
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) Written exam 90 min
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** Bachelor MB Pflicht Bachelor WI-MB Bachelor Mechatronik, Computational Engineering, BEd. Metalltechnik
8	**Grade bonus compliant to §25 (2)**
9	**References** Gross, Hauger, Schröder, Wall: Technische Mechanik I: Statik, 4. Auflage 2009, Springer Verlag.

Courses				
	Course Nr. 16-64-5190-vl	**Course name** Engineering Mechanics I (Statics)		
	Instructor		**Type** Lecture	**SWS** 3
	Course Nr. 16-64-5190-gü	**Course name** Engineering Mechanics I (Statics) - Group Exercise		
	Instructor		**Type** Group practice	**SWS** 2
	Course Nr. 16-64-5190-hü	**Course name** Engineering Mechanics I (Statics)		
	Instructor		**Type** Lecture hall practice	**SWS** 1

Module name Engineering Mechanics II (Elastostatics)					
Module nr. 16-61-5010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Wilfried Becker		

1	**Teaching content** Stresses in 2D and 3D representation, deformation and strain rate, Hooke's law, strength hypotheses, bending of beams, deflection curve, shear influence, torsion, energy principles in elastostatics, stability and buckling.
2	**Learning objectives** The students will have an understanding of the essential basics of the elasto-statics of one-dimensional continua (rods, beams, torsion shafts). They will be capable of modelling such systems mathematically, solving the corresponding mathematical equations and interpreting the solutions.
3	**Recommended prerequisites for participation** Engineering Mechanics I (Statics)
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module**
8	**Grade bonus compliant to §25 (2)**
9	**References** Gross; Hauger; Schnell; Schröder: Technische Mechanik 2, Elastostatik, Springer Verlag. Gross; Ehlers; Wriggers: Formeln und Aufgaben zur Technischen Mechanik 2, Springer Verlag. Peter Hagedorn: Technische Mechanik, Band 2, Festigkeitslehre, Verlag Harri Deutsch, 2006. Supplementary material on the institute's homepage.

Courses

	Course Nr. 16-61-5010-vl	**Course name** Engineering Mechanics II (Elastostatics)		
	Instructor		**Type** Lecture	**SWS** 3
	Course Nr. 16-61-5010-gü	**Course name** Engineering Mechanics II (Elastostatics) - Group Exercise		
	Instructor		**Type** Group practice	**SWS** 2
	Course Nr. 16-61-5010-hü	**Course name** Engineering Mechanics II (Elastostatics)		
	Instructor		**Type** Lecture hall practice	**SWS** 1

Module name Engineering Mechanics III (Dynamics)					
Module nr. 16-25-5120	**Credit points** 6 CP	**Workload** 180 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Bernhard Schweizer		

1	**Teaching content** Kinematics of points and rigid bodies, relative kinematics, kinetics of rigid bodies, work and energy, vibrations, impact, principles of mechanics (d'Alembert's principle, Lagrange's equations).
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Describe planar and spatial motions of point masses and rigid bodies. 2. Analyse dynamical problems and derive the equations of motion for simple mechanical systems. 3. Apply Newton´s and Euler´s laws in order to solve dynamical problems. 4. Model simple vibration systems and solve simple differential equations. 5. Apply the principles of mechanics.
3	**Recommended prerequisites for participation** Mathematics I, Engineering Mechanics I (Statics) recommended
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** Bachelor MB Pflicht Bachelor WI-MB Bachelor Mechatronik
8	**Grade bonus compliant to §25 (2)**
9	**References** Markert, R.: Technische Mechanik, Teil B (Dynamik), 2. Auflage, 2009. Hagedorn, P.: Technische Mechanik, Band 3: Dynamik, 3. Auflage, Verlag Harri Deutsch, Frankfurt 2006. Hibbeler, R. C.: Engineering Mechanics: Dynamics, 3rd Edition, Prentice Hall, 2004.

Courses

Course Nr. 16-25-5120-vl	**Course name** Engineering Mechanics III (Dynamics)		
Instructor		**Type** Lecture	**SWS** 3
Course Nr. 16-25-5120-gü	**Course name** Engineering Mechanics III (Dynamics) - Group Exercise		
Instructor		**Type** Group practice	**SWS** 2

	Course Nr. 16-25-5120-hü	**Course name** Engineering Mechanics III (Dynamics)		
	Instructor		**Type** Lecture hall practice	**SWS** 1

4 More Fundamentals

Module name Materials Technology for Mechatronics					
Module nr. 16-08-6420	**Credit points** 3 CP	**Workload** 90 h	**Self study** 60 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Dr. Ing. Daniela Schwerdt		
1	**Teaching content** Aims and terms of materials technology, metallurgy, alloying and manufacturing processess of metallic components, light alloys, plastics, loading and strength, high temperature loading, corrosion and tribology.				
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Present the atomic and crystal structure of materials and to explain features of materials. 2. Describe the most important structural materials with their properties and materials values. 3. Assess components under different loading conditions.				
3	**Recommended prerequisites for participation** None				
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 60 Min., Default RS)				
5	**Prerequisite for the award of credit points** Passing the final module examination				
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)				
7	**Usability of the module**				
8	**Grade bonus compliant to §25 (2)**				
9	**References**				
Courses					
	Course Nr. 16-08-6400-vl	**Course name** Materials Technology for Computational Engineering, Materials Technology for Mechatronics			
	Instructor			**Type** Lecture	**SWS** 2

Module name General Computer Science I					
Module nr. 20-00-0304	**Credit points** 5 CP	**Workload** 150 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Prof. Dr. rer. nat. Karsten Weihe		

1	**Teaching content**
2	**Learning objectives** • Basic Knowledge of Computer Science Concepts • Practical Work with computers • Fundamental Programming Skills
3	**Recommended prerequisites for participation** -
4	**Form of examination** Course related exam: • [20-00-0304-iv] (Technical examination, Oral/written examination, Default RS)
5	**Prerequisite for the award of credit points** Pass exam (100%)
6	**Grading** Course related exam: • [20-00-0304-iv] (Technical examination, Oral/written examination, Weighting: 100 %)
7	**Usability of the module**
8	**Grade bonus compliant to §25 (2)**
9	**References** David J. Barnes und Michael Kölling, Objects First with Java: A Practical Introduction using BlueJ, Fifth edition, Prentice Hall/Pearson Education, 2012, ISBN 978-013-249266-9

Courses

Course Nr.	**Course name**		
20-00-0304-iv	General Computer Science I		
Instructor		**Type** Integrated course	**SWS** 2

Module name Computer Aided Design (CAD)					
Module nr. 16-07-5020	**Credit points** 4 CP	**Workload** 120 h	**Self study** 60 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr. Reiner Anderl		

1	**Teaching content** Parametric 3D CAD systems, PDM systems, 3D hand sketching, geometric models, design of single parts with geometric elements, features and parametrics, assembly modeling, bill of materials, tolerances and surface fits, technical product documentation, drawing standards, product development in teams.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Understand and apply parametric 3D CAD and PDM systems. 2. Design parametric single parts and complex assemblies. 3. Create engineering drawings for documentation. 4. Manage generated product data using PDM processes. 5. Work on and solve advanced tasks in virtual product development in teams.
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Special form, Default RS) Product modelling project (continuous assessment procedure: Reports on component modeling, assembly.
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Special form, Weighting: 100 %)
7	**Usability of the module** Bachelor MB Pflicht Bachelor WI-MB WP Projekte Bachelor Mechatronik
8	**Grade bonus compliant to §25 (2)**
9	**References** Lecture notes can be purchased in the institute's secretarial office. Exercises and background theory are available on the website.

Courses

	Course Nr. 16-07-5020-vl	**Course name** Computer Aided Design (CAD)		
	Instructor		**Type** Lecture	**SWS** 1
	Course Nr. 16-07-5020-ue	**Course name** Computer Aided Design (CAD)		
	Instructor		**Type** Practice	**SWS** 1

	Course Nr. 16-07-5020-tt	**Course name** Computer Aided Design (CAD)		
	Instructor		**Type** Tutorial	**SWS** 2

Module name Technical Thermodynamics I					
Module nr. 16-14-5010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 105 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Prof. Dr.-Ing. Peter Stephan		

1	**Teaching content** Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of energy (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substances; first law of thermodynamics and energy balances for technical systems; second law of thermodynamics and entropy balances for technical systems; exergy analysis; thermodynamic behaviour during phase change; the carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cyclic processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system and apply them within calculations of thermal system behaviour. 2. Distinguish between different types of energy (e.g. work, heat, internal energy, enthalpy) and define them. 3. Analyse technical systems and processes using energy balances and equations of state. 4. Assess energy conversion processes by means of an entropy balance or an exergy analysis. 5. Characterise the thermal behaviour of gases, liquids and solids and corresponding phase change processes. 6. Apply this basic knowledge (1.-5.) to examine machines (turbines, pumps etc.) and processes for energy conversion (combustion engine, power plants, refrigerators, heat pumps).
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 150 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** Bachelor MB Pflicht Bachelor WI-MB Master ETiT MFT, Bachelor Mechatronik
8	**Grade bonus compliant to §25 (2)**
9	**References** P. Stephan; K. Schaber; K. Stephan; F. Mayinger: Thermodynamik, Band 1: Einstoffsysteme, Springer Verlag. Further material (slides, collection of exercises, table of fomulas etc.) is available through the Moodle system of TU Darmstadt.
Courses	

	Course Nr. 16-14-5010-vl	**Course name** Technical Thermodynamics I		
	Instructor		**Type** Lecture	**SWS** 3
	Course Nr. 16-14-5010-gü	**Course name** Technical Thermodynamics I - Group Exercise		
	Instructor		**Type** Group practice	**SWS** 1
	Course Nr. 16-14-5010-hü	**Course name** Technical Thermodynamics I		
	Instructor		**Type** Lecture hall practice	**SWS** 1

Module name Electronics					
Module nr. 18-ho-1010	**Credit points** 4 CP	**Workload** 120 h	**Self study** 75 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Klaus Hofmann		

1 Teaching content

Semiconductor Devices: Diode, MOSFET, Bipolar Transistor; Design of Electronic Circuits;
Analog Circuits: Basic Properties, Properties and Application of Operational Amplifiers, Circuit Simulation with SPICE, Small Signal Gain, Single Stage Amplifiers; Frequency Response;
Digital Circuits: CMOS Logic Circuits

2 Learning objectives

A student is, after successful completion of this module, able to

1. analyse Diodes, MOS- und Bipolartransistors in simple circuits
2. calculate the properties of single transistor circuits, such as small signal gain, input and output resistance
3. design inverting and non-inverting amplifiers from operational amplifiers and knows their ideal and non-ideal properties
4. calculate the frequency behavior of simple transistor circuits
5. distinguish the different methods to construct a logical gate from basic transistors and explain their fundamental properties.

3 Recommended prerequisites for participation

Basics of Electrical Engineering

4 Form of examination

Module exam:

- Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Examination, Weighting: 100 %)

7 Usability of the module

BSc ETiT, BSc Wi-ETiT,BSc iST, BEd

8 Grade bonus compliant to §25 (2)

A grade improvement of up to 0,4 due to a bonus is possible, which can be earned with tests.

9 References

Lecture Slide Copies; Richard Jaeger: Microelectronic Circuit Design

Courses

Course Nr. 18-ho-1011-vl	**Course name** Electronics		
Instructor Prof. Dr.-Ing. Klaus Hofmann, M.Sc. Oliver Bachmann		**Type** Lecture	**SWS** 2

	Course Nr. 18-ho-1011-ue	**Course name** Electronics		
	Instructor Prof. Dr.-Ing. Klaus Hofmann, M.Sc. Oliver Bachmann		**Type** Practice	**SWS** 1

Module name Programming in Automatic Control (C/C++)					
Module nr. 18-ad-1020	**Credit points** 2 CP	**Workload** 60 h	**Self study** 30 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Jürgen Adamy		

1	**Teaching content** Programming in LINUX, Makefiles, C - Programming (Program structures in C, pointer, developer environment and debugger), C++ (object oriented programming)
2	**Learning objectives** After attending the lecture, a student is capable of: 1. operating LINUX computers, 2. assembling and using makefiles, 3. recalling and applying the syntax for standard C-blocks, 4. explaining and applying the use of pointers, 5. explaining the concept of object oriented programming in C++
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc iST, MSc MEC, MSc Wi-ETiT
8	**Grade bonus compliant to §25 (2)**
9	**References** Adamy: Lecture notes

Courses

	Course Nr. 18-ad-1020-vl	**Course name** Programming in Automatic Control (C/C++)		
	Instructor Dr. rer. nat. Tatiana Tatarenko		**Type** Lecture	**SWS** 1
	Course Nr. 18-ad-1020-ue	**Course name** Programming in Automatic Control (C/C++)		
	Instructor Dr. rer. nat. Tatiana Tatarenko		**Type** Practice	**SWS** 1

Module name					
Fluid Mechanics for Mechatronics					
Module nr.	**Credit points**	**Workload**	**Self study**	**Module duration**	**Module cycle**
16-10-6400	4 CP	120 h	75 h	1 Term	Summer term
Language			**Module owner**		
German			Prof. Dr.-Ing. Peter Pelz		

1	**Teaching content** Fluid properties, hydrostatic laws, volume forces, pressure forces on walls, Bernoulli equation in stationary and rotating systems, conservation law of momentum, airfoil and cascade flows, flow of viscous fluids in gaps and pipes, boundary layers.
2	**Learning objectives** Students acquire knowledge of elementary fluid mechanics and corresponding computational possibilities. They will be able to discern which one-dimensional equations are suited for simple fluid dynamic problems and applications and to carry out respective calculations. They are familiar with numerous solution examples upon which they can fall back.
3	**Recommended prerequisites for participation** none
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module**
8	**Grade bonus compliant to §25 (2)**
9	**References** Study material at www.fst.tu-darmstadt.de Recommended books: E. Becker: Technische Strömungslehre, Teubner Studienbücher

Courses

	Course Nr. 16-10-6400-vl	**Course name** Fluid Mechanics for Mechatronics		
	Instructor		**Type** Lecture	**SWS** 2
	Course Nr. 16-10-6400-ue	**Course name** Fluid Mechanics for Mechatronics		
	Instructor		**Type** Practice	**SWS** 1

Module name Measuring Technique					
Module nr. 18-kn-1011	**Credit points** 6 CP	**Workload** 180 h	**Self study** 105 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr. Mario Kupnik		

1 Teaching content

The module includes theoretical discussion and practical application of the measuring chain in detail on example the electrical variables (current, voltage, impedance, power) and selected non-electrical variables (frequency, time, force, pressure and acceleration).
In the lecture the following chapter will be thematically treated measuring signals and measuring equipment (oscilloscope, laboratory testing equipment), static measurement error and disturbance variables (especially temperature), basic measurement circuits, AD conversion principles and filtering, measurement method non-electrical variables and the statistics of measurements (distributions, statist safe tests).
The topics of the lecture are discussed in the exercise of the module. Examples are analyzed and their application in measurement scenarios are practiced.
The practicum of the module consists of five experiments which are time closely matched in time to the lecture:

- Measuring of signals in the time range with digital storage oscilloscope, trigger conditions
- Measuring of signals in the frequency range with digital storage oscilloscope, error of measurement (aliasing / subsampling, leackage) and window functions
- Measuring of mechanical dimensions with suitable primary sensors, sensor electronics / amplifier circuits
- computer-based measuring
- Importing of sensor signals, whose processing and the resulting automated control of a process using a programmable logic controller (PLC)

2 Learning objectives

The students know the structure of the measuring chain and the specific properties of the corresponding elements. They know the structure of electronic measuring instruments and basic measuring circuits for electrical and selected non-electrical variables and can apply them. They know the basics of capturing, processing, transferring and storage of measurement data and can describe error sources and quantifying their influences.
In the practicum, the students deepen the basis of the measurements with the oscilloscope, the understanding of the relationship between time and frequency range. Methodically they are able to document and evaluate the data during laboratory measuring.

3 Recommended prerequisites for participation

Basics of ETiT I-III, Math I-III, Electronic

4 Form of examination

Module exam:

- Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)

Course related exam:

- [18-kn-1011-pr] (Study achievement, Optional, Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Examination, Weighting: 4)

Course related exam:

- [18-kn-1011-pr] (Study achievement, Optional, Weighting: 2)

7 Usability of the module

	BSc ETiT, BSc Wi-ETiT, BSc MEC			
8	**Grade bonus compliant to §25 (2)**			
9	**References** • Slide set of lecture • Textbook and exercise book Lerch: „Elektrische Messtechnik“, Springer • Exercise documents • Practical experiment manuals			
Courses				
	Course Nr. 18-kn-1011-vl	**Course name** Measuring Technique		
	Instructor Prof. Dr. Mario Kupnik		**Type** Lecture	**SWS** 2
	Course Nr. 18-kn-1011-ue	**Course name** Measuring Technique		
	Instructor Prof. Dr. Mario Kupnik		**Type** Practice	**SWS** 1
	Course Nr. 18-kn-1011-pr	**Course name** Measuring Technique Lab		
	Instructor Prof. Dr. Mario Kupnik		**Type** Internship	**SWS** 2

Module name Logic Design					
Module nr. 18-sm-1040	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr. rer. nat. Björn Scheuermann		

1	**Teaching content** Boolean algebra, logic gates, hardware description languages, flipflops, sequential circuits, state-diagrams and -tables, technology mapping, programmable logic circuits
2	**Learning objectives** By this module, Students will be enabled to • rewrite boolean expressions and transform them into circuits of logic gates • analyze and synthesize digital circuits • describe digital circuits in a hardware description language • extract finite state machines from informal descriptions and implement them with synchronous circuits
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc MEC, BSc Wi-ETiT
8	**Grade bonus compliant to §25 (2)**
9	**References** David Harris und Sarah Harris: Digital Design and Computer Architecture

Courses

	Course Nr. 18-sm-1040-vl	**Course name** Logic Design		
	Instructor Prof. Dr. rer. nat. Björn Scheuermann		**Type** Lecture	**SWS** 3
	Course Nr. 18-sm-1040-ue	**Course name** Logic Design		
	Instructor Prof. Dr. rer. nat. Björn Scheuermann		**Type** Practice	**SWS** 1

Module name Electrical Machines and Drives					
Module nr. 18-bi-1020	**Credit points** 5 CP	**Workload** 150 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr. techn. Dr.h.c. Andreas Binder		

1	**Teaching content** Construction and function of induction machine, synchronous machine, direct current machine. Electromagnetic field within machines, armature windings, steady-state performance as motor/generator, application as line-fed and inverter-fed drives. Significance for electric power generation, both to the grid and in stand-alone version.
2	**Learning objectives** With active collaboration during lectures by asking questions related to those parts, which have not been completely understood by you, as well as by independent solving of examples ahead of the tutorial (not as late as during preparation for examination) you should be able to: 1. calculate and explain the stationary operation performance of the three basic types of electric machine sin motor and generator mode, 2. understand the application of electrical machines in modern drive systems and to design simple drive applications by yourself, 3. understand and explain the function and physical background of the components of electrical machines 4. understand and explain the impact of basic electromagnetic field and force theory on the basic function of electrical machines.
3	**Recommended prerequisites for participation** Mathematics I to III, Electrical Engineering I and II, Physics, Mechanical Engineering
4	**Form of examination** Module exam: • Module exam (Technical examination, Optional, Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Optional, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc/MSc Wi-ETiT, BEd
8	**Grade bonus compliant to §25 (2)**
9	**References** Detailed textbook and collection of exercices; Complete set of PowerPoint presentations L.Matsch: Electromagnetic and electromechanical machines, Int.Textbook, 1972 A.Fitzgerald et al: Electric machinery, McGraw-Hill, 1971 S.Nasar et al: Electromechanics and electric machines, Wiley&Sons, 1995 R.Fischer: Elektrische Maschinen, C.Hanser-Verlag, 2004
Courses	

	Course Nr. 18-bi-1020-vl	**Course name** Electrical Machines and Drives		
	Instructor Prof. Dr. techn. Dr.h.c. Andreas Binder		**Type** Lecture	**SWS** 2
	Course Nr. 18-bi-1020-ue	**Course name** Electrical Machines and Drives		
	Instructor Prof. Dr. techn. Dr.h.c. Andreas Binder		**Type** Practice	**SWS** 2

Module name Mechanical Components and System Behaviour for Mechatronics					
Module nr. 16-24-6400	**Credit points** 4 CP	**Workload** 120 h	**Self study** 75 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Stephan Rinderknecht		

1	**Teaching content**
2	**Learning objectives**
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 100 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module**
8	**Grade bonus compliant to §25 (2)**
9	**References**

Courses

	Course Nr. 16-24-6400-vl	**Course name** Mechanical components and system behaviour for Mechatronics		
	Instructor		**Type** Lecture	**SWS** 2
	Course Nr. 16-24-6400-ue	**Course name** Mechanical components and system behaviour for Mechatronics		
	Instructor		**Type** Practice	**SWS** 1

Module name System Dynamics and Automatic Control Systems I					
Module nr. 18-ko-1010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Ulrich Konigorski		

1	**Teaching content** Description and classification of dynamic systems; Linearization around an equilibrium point; Stability of dynamic systems; Frequency response; Linear time-invariant closed-loop systems; Controller design; Control structure optimization
2	**Learning objectives** Students will know how to describe and classify different dynamic systems. They will be able to analyse the dynamic behaviour in time and frequency domain. The students will be able to design controllers for linear time invariant systems.
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc MEC, MSc Informatik
8	**Grade bonus compliant to §25 (2)**
9	**References** • Skript Konigorski: "Systemdynamik und Regelungstechnik I", Aufgabensammlung zur Vorlesung, Lunze: "Regelungstechnik 1: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen", • Föllinger: "Regelungstechnik: Einführung in die Methoden und ihre Anwendungen", • Unbehauen: "Regelungstechnik I:Klassische Verfahren zur Analyse und Synthese linearer kontinuierlicher Regelsysteme, Fuzzy-Regelsysteme", Föllinger: "Laplace-, Fourier- und z-Transformation", • Jörgl: "Repetitorium Regelungstechnik", • Merz, Jaschke: "Grundkurs der Regelungstechnik: Einführung in die praktischen und theoretischen Methoden", • Horn, Dourdoumas: "Rechnergestützter Entwurf zeitkontinuierlicher und zeitdiskreter Regelkreise", • Schneider: "Regelungstechnik für Maschinenbauer", • Weinmann: "Regelungen. Analyse und technischer Entwurf: Band 1: Systemtechnik linearer und linearisierter Regelungen auf anwendungsnaher Grundlage"
Courses	

	Course Nr. 18-ko-1010-vl	**Course name** System Dynamics and Automatic Control Systems I		
	Instructor M.Sc. Florian Weigand, Prof. Dr.-Ing. Ulrich Konigorski		**Type** Lecture	**SWS** 3
	Course Nr. 18-ko-1010-tt	**Course name** System Dynamics and Automatic Control Systems I- Auditorium Exercise		
	Instructor M.Sc. Florian Weigand, Prof. Dr.-Ing. Ulrich Konigorski		**Type** Tutorial	**SWS** 1

Module name Laboratory Course Control of Mechatronic Systems					
Module nr. 18-ko-1040	**Credit points** 4 CP	**Workload** 120 h	**Self study** 60 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Ulrich Konigorski		

1 Teaching content

- Control of a 2-tank system.
- Control of pneumatic and hydraulic servo-drives.
- Control of a 3 mass oscillator.
- Position control of a MagLev system.
- Control of a discrete transport process with electro-pneumatic components.
- Microcontroller-based control of an electrically driven throttle valve.
- Identification of a 3 mass oscillator.
- Process control using PLC.

2 Learning objectives

After this lab tutorial the students will be able to practically apply the modelling and design techniques for different dynamic systems presented in the lecture ”System dynamics and control systems I” to real lab experiments and to bring them into operation at the lap setup.

3 Recommended prerequisites for participation

System Dynamics and Control Systems I

4 Form of examination

Module exam:

- Module exam (Study achievement, Examination, Duration: 90 Min., Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Study achievement, Examination, Weighting: 100 %)

7 Usability of the module

BSc MEC

8 Grade bonus compliant to §25 (2)

9 References

Lab handouts will be given to students

Courses

Course Nr.	**Course name**		
18-ko-1020-pr	Laboratory Control Engineering I		
Instructor Prof. Dr.-Ing. Ulrich Konigorski		**Type** Internship	**SWS** 4

Module name Actuators for Mechatronic Systems Laboratory					
Module nr. 18-bi-1030	**Credit points** 4 CP	**Workload** 120 h	**Self study** 75 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr. techn. Dr.h.c. Andreas Binder		

1	**Teaching content** Safety instructions; Practical experiments about electrical energy conversion and mechatronic actuators: • Record preparation (one for each group) for every experiment. • One exam for all practical experiments at the end of the semester. • The mark for the students result from the practical experiments, the prepared records and the results of the 2 short exams.
2	**Learning objectives** The use of mechanical actors is trained and knowledge in using the actors is acquired.
3	**Recommended prerequisites for participation** Recommended lecture "Elektrische Antriebe (MEC)" and "Maschinenelemente und Mechatronik 1"
4	**Form of examination** Module exam: • Module exam (Study achievement, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Study achievement, Examination, Weighting: 100 %)
7	**Usability of the module** BSc MEC
8	**Grade bonus compliant to §25 (2)**
9	**References** Detailed textbook with description for the performance of the lab tests

Courses

	Course Nr. 18-bi-1030-pr	**Course name** Actuators for Mechatronic Systems Laboratory		
	Instructor Prof. Dr. techn. Dr.h.c. Andreas Binder		**Type** Internship	**SWS** 3
	Course Nr. 18-bi-2090-tt	**Course name** Laboratory Briefing		
	Instructor Prof. Dr. techn. Dr.h.c. Andreas Binder		**Type** Tutorial	**SWS** 0

5 Optional Modules

5.1 Optional Catalog ETiT: Electrical Engineering and Information Technology

Module name Electrical Power Engineering					
Module nr. 18-bi-1010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr. techn. Dr.h.c. Andreas Binder		

1	**Teaching content** The lecture gives an introduction to the technical processes for the use of energy for the human civilization in general and to the basic tasks and challenges of the electrical energy in particular. Biochemical energy processes such as the human metabolism are therefore not subject of the course. First, the physical basics of the term "energy" are repeated and the different forms of energy (mechanical, thermal, electromagnetic, chemical and nuclear) are explained in terms of the technical use of energy as heat, mechanical movement and electricity. Then, an overview of the energy resources is given, starting from the solar radiation and its direct and indirect impact, such as the solar heat and the motion of air mass, surface water and sea waves. Next, the energy source of biomass due to solar radiation and the fossil energy sources oil, natural gas and coal will be discussed. The energy sources of nuclear fission (uranium deposits) and nuclear fusion (heavy water), and geothermal energy due to nuclear effects in the Earth's interior are explained as well as the tidal effects caused by planetary motion. The increasing energy demand of the rapidly growing world population and the geographic distribution of energy sources (deposits, acreage, solar radiation, wind maps, tidal currents, ...) are described. The resulting energy flows on transport routes such as pipelines, waterways, ..., are briefly presented. In another section, energy conversion processes (direct and indirect methods) are illustrated. Large-scale processes such as thermal cycles or hydraulic processes in power plants are discussed mainly, but also marginal processes such as thermionic converters are addressed. Afterwards, a specialization takes place on the subject of electric power supply with respect to the increasing proportion of the electric power applications. The chain from the electric generator to the consumer with an overview of the required resources, the hiring electrical load flow and its stability is addressed. The storage of energy and in particular of electrical energy by converting into other forms of energy will be discussed. Finally, questions for the contemporary use of energy resources in regard to sustainability are mentioned.
2	**Learning objectives** Students know the physically based energy basics and have an overview of the energy resources of our planet Earth. They understand the fundamental energy conversion processes on the technical use of energy in the form of heat as well as mechanical and electrical work. They have acquired basic knowledge of electrical engineering in the chain of effects from electric power producer to the consumer and are able to educate themselves about current issues of energy use and its future development. They are able to perform basic calculations for energy content, energy conversion, efficiencies, storage, and for conversion and transportation losses. They are prepared for advanced lectures on energy components and systems, energy industry, and on future forms of energy supply.
3	**Recommended prerequisites for participation**

	Basic knowledge of physics (mechanics, thermodynamics, electrical engineering, structure of matter) and chemistry (binding energy) are desirable and facilitate understanding of the energetic processes.
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc WI-ETiT, BSc MEC, BSc iST, BSc CE, MSc ESE
8	**Grade bonus compliant to §25 (2)** At the beginning of the semester, it will be announced whether there will be homework tests accompanying the lecture that will enable an improvement in grades.
9	**References** Lecture notes (slides) Practice documents (examples, solutions) Additional and more detailed literature: • Grothe/Feldhusen: Dubbel-Taschenbuch für den Maschinenbau, Springer, Berlin, 2007, 22. Aufl.; besonders: Kapitel „Energietechnik und Wirtschaft“ • Sterner/Stadler: Energiespeicher - Bedarf, Technologien, Integration, Springer-Vieweg, Berlin, 2011 • Rummich: Energiespeicher, expert-verlag, Renningen, 2015, 2. Aufl. • Strauß: Kraftwerkstechnik zur Nutzung fossiler, nuklearer und regenerativer Energiequellen, Springer, Berlin, 2006, 5. Aufl. • Hau: Windkraftanlagen -Grundlagen, Technik, Einsatz, Wirtschaftlichkeit, Springer-Vieweg, Berlin, 2014, 5. Aufl. • Heuck/Dettmann/Schulz: Elektrische Energieversorgung, Springer-Vieweg, Berlin, 2014, 9. Aufl. • Quaschning: Regenerative Energiesystem, Hanser, München, 2001, 7. Aufl.

Courses

Course Nr. 18-bi-1010-vl	**Course name** Electrical Power Engineering		
Instructor Prof. Dr. techn. Dr.h.c. Andreas Binder		**Type** Lecture	**SWS** 3
Course Nr. 18-bi-1010-ue	**Course name** Electrical Power Engineering		
Instructor Prof. Dr. techn. Dr.h.c. Andreas Binder		**Type** Practice	**SWS** 1

Module name Introduction to Electrodynamics					
Module nr. 18-dg-1010	**Credit points** 5 CP	**Workload** 150 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Herbert De Gersem		

1	**Teaching content** Vector calculus, orthogonal coordinate systems, Maxwell's equations, interface and boundary conditions, layered media, electrostatics, scalar potential, Coulomb integral, separation of variables, method of image charges, magnetostatics, vector potential, Biot-Savart law, stationary current fields, fields in matter, energy flow, skin effect, plane waves, polarization, TEM waves, reflection and multi-layer problems, multi conductor transmission lines (capacitance, inductance, and conductance matrix), velocity definitions, basics of rectangular waveguides.
2	**Learning objectives** Students will be familiar with Maxwell's equations in integral and differential form for static and dynamic field problems. They will have a mental picture of wave phenomena in free space. They are able to recognice and interpret wave effects in the different areas of electrical engineering. They are able to derive the wave effects from Maxwell's equations and have a good understanding of the necessary mathematical tools.
3	**Recommended prerequisites for participation** Lecture notes. Further literature recommendations are given in the course.
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 180 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc Wi-ETiT
8	**Grade bonus compliant to §25 (2)** Improvement by up to 0.4 due to bonus points which can be acquired by means of e-learning online tests.
9	**References** Lecture notes. Further literature recommendations are given in the course.

Courses

	Course Nr. 18-dg-1010-vl	**Course name** Introduction to Electrodynamics	
	Instructor Prof. Dr.-Ing. Herbert De Gersem	**Type** Lecture	**SWS** 2
	Course Nr. 18-dg-1010-ue	**Course name** Introduction to Electrodynamics	
	Instructor Prof. Dr.-Ing. Herbert De Gersem	**Type** Practice	**SWS** 2

Module name Fundamentals of Signal Processing					
Module nr. 18-zo-1030	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Abdelhak Zoubir		

1 Teaching content

The course covers the following topics:

- The basic concepts of stochastic
- The sampling theorem
- Discrete-time noise processes and their properties
- Description of noise processes in the frequency domain
- Linear time-invariant systems: FIR and IIR filters
- Filtering of noise processes: AR, MA, and ARMA models
- The Matched filter
- The Wiener filter
- Properties of estimators
- The method of least squares

2 Learning objectives

The course covers basic concepts of signal processing, and illustrates them with practical examples. It serves as an introductory course for advanced lectures in digital signal processing, adaptive filtering, communications, and control theory.

3 Recommended prerequisites for participation

4 Form of examination

Module exam:

- Module exam (Technical examination, Oral/written examination, Duration: 120 Min., Default RS)

In general, the examination takes place in form of a written exam (duration: 120 minutes). If up to 10 students register in semesters in which the lecture does not take place, there will will be an oral examination (duration: 30 min.). The type of examination will be announced within one working week after the end of the examination registration phase.

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Oral/written examination, Weighting: 100 %)

7 Usability of the module

BSc ETiT, BSc MEC

8 Grade bonus compliant to §25 (2)

9 References

Lecture notes and slides can be downloaded here:

- http://www.spg.tu-darmstadt.de
- Moodle platform

Further reading:

- A. Papoulis: Probability, Random Variables and Stochastic Processes. McGraw-Hill, Inc., third edition, 1991.
- P. Z. Peebles, Jr.: Probability, Random Variables and Random Signal Principles. McGraw-Hill, Inc., fourth edition, 2001.
- E. Hänsler: Statistische Signale; Grundlagen und Anwendungen. Springer Verlag, 3. Auflage, 2001.
- J. F. Böhme: Stochastische Signale. Teubner Studienbücher, 1998.
- A. Oppenheim, W. Schafer: Discrete-time Signal Processing. Prentice Hall Upper Saddle River,1999.

Courses

Course Nr.	**Course name**		
18-zo-1030-vl	Fundamentals of Signal Processing		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Abdelhak Zoubir		Lecture	3

Course Nr.	**Course name**		
18-zo-1030-ue	Fundamentals of Signal Processing		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Abdelhak Zoubir		Practice	1

Module name Communication Technology I					
Module nr. 18-kl-1020	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Anja Klein		

1	**Teaching content** Signals and Communication Systems, Base-band Communications, Detection of Base-band Signals in AWGN Channels, Bandpass-Signals und -Systems, Linear Digital Modulation Schemes, Digital Modulation und Detection, Multi-carier Transmission, OFDM, Spread-Spectrum Techniques, CDMA, Multiple Access
2	**Learning objectives** After completion of the module, students possess the ability to: • classify signals and communication systems, • understand, model and analyse basic components of communication systems, • understand, evaluate and compare communication systems for transmission over additive white Gaussian noise channels, • model and analyse base-band commnication systems, • describe and analyse bandpass signals and bandpass communication systems in the equivalent base-band, • understand, model, evaluate, compare and apply linear modulation schemes, • design receiver structures for different modulation schemes, • detect linear modulated data after transmission over additive white Gaussian noise channels in an optimum way, • understand and model OFDM, • understand and model CDMA, • understand and compare the basic properties of multiple access schemes.
3	**Recommended prerequisites for participation** Electrical Engineering I and II, Deterministische Signale und Systeme, Mathematics I to III, Statistics/Probability Theory, Scientific Computing
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc Wi-ETiT, BSc CE, MSc iST, BSc MEC
8	**Grade bonus compliant to §25 (2)**
9	**References** Will be announced in the lecture
Courses	

	Course Nr. 18-kl-1020-vl	**Course name** Communication Technology I		
	Instructor Prof. Dr.-Ing. Anja Klein		**Type** Lecture	**SWS** 3
	Course Nr. 18-kl-1020-ue	**Course name** Communication Technology I		
	Instructor Prof. Dr.-Ing. Anja Klein, Dr. rer. nat. Sabrina Klos		**Type** Practice	**SWS** 1

Module name Power Electronics					
Module nr. 18-gt-1010	**Credit points** 5 CP	**Workload** 150 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Gerd Griepentrog		

1 Teaching content

Power electronic devices convert the energy from the distribution network to the form required by the load. This conversion does not wear out, can be controlled very fast and has a high efficiency. In lecture “Power Electronics“ the most important circuits required for the energy conversion are treated, using ideal switches.
The main chapters are
I.) Line commutated converters in order to understand the basic concepts of power electronic systems.
II.) Self- commutated converters (one, two and four quadrant converters, 3-phase- VSI)

2 Learning objectives

The module teaches students after successful completion:

- Understand the ideal concept of power semiconductors
- Calculate and sketch the time-characteristics of all currents and voltages in a line-commutated converter using defined simplifications as well as represent the behavior of currents and voltages during commutation in line-commutated converters for center -tapped as well as for bridge circuits.
- Specify the basic circuit diagrams for one, two and four quadrant DC/DC converters and calculate the characteristics of voltages and currents in these circuits.
- Explain the function of single-phase and three-phase voltage source inverters and calculate the currents and voltages in these circuits using defined simplifications.
- Understannd the concept und operation of HVDC converter

3 Recommended prerequisites for participation

Mathe I und II, ETiT I und II, Energietechnik

4 Form of examination

Module exam:

- Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Examination, Weighting: 100 %)

7 Usability of the module

MSc ETiT, MSc MEC, Wi-ETiT

8 Grade bonus compliant to §25 (2)

9 References

Lecture notes, instructions for exercises are available for download in Moodle.
Literature:

- Probst U.: „Leistungselektronik für Bachelors: Grundlagen und praktische Anwendungen“, Carl Hanser Verlag GmbH & Co. KG, 2011
- Jäger, R.: „Leistungselektronik: Grundlagen und Anwendungen“, VDE-Verlag; Auflage 2011
- Heumann, K.: „Grundlagen der Leistungselektronik“; Teubner; Stuttgart; 1985
- Lappe, R.: „Leistungselektronik“; Springer-Verlag; 1988
- Mohan, Undeland, Robbins: Power Electronics: Converters, Applications and Design; John Wiley Verlag; New York; 2003

Courses

Course Nr.	**Course name**		
18-gt-1010-vl	Power Electronics		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Gerd Griepentrog		Lecture	2
Course Nr.	**Course name**		
18-gt-1010-ue	Power Electronics		
Instructor		**Type**	**SWS**
Prof. Dr.-Ing. Gerd Griepentrog, M.Sc. Milad Khani		Practice	2

Module name Fundamentals of Communication					
Module nr. 18-jk-1010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Rolf Jakoby		

1	**Teaching content** Part 1: Chap. 1 will be a brief introduction in "Electrical Information- and Communication Engineering", presenting signals as carrier of information, classifying electrical signals and describing elements of communication systems. Then, Chap. 2 introduces various line-conducted and wireless transmission media, power budget calculations for both media types, basics of antenna radiation and parameters etc., which will be emphasized by application examples like TV-satellite reception and mobile communication channels. Part 2: Chap. 3 is focused on signal distortions and interferences, especially thermal noise, considering noisy two-port devices and its concatenations, lossy networks, antenna noise temperature and the impact of noise on analog and digital signals. This chap. ends with basics of information theory and channel capacity for AWGN-channels. In contrast, chap 4 deals with noise-reduction and distortion-compensation methods. Part 3: Chap. 5 introduces sampling of band-limited signals and analog modulation of a pulse carrier (pulse-amplitude- pulse-duration- and pulse-angle-modulation), which will be extended on digital modulation in the baseband by means of pulse-code modulation (PCM), focusing on signal quantizing, analog-digital conversion, minimum bandwidth, bit error rate and error probability of a PCM word. At least, PCM-time-division multiplex and -systems will be discussed. Part 4: Chap. 7 deals with fundamentals of multiplex- and RF-modulation schemes as well as with frequency conversion, frequency multiplication and mixing strategies. Then, receiver principles and image frequency problems of heterodyne-receivers as well as amplitude modulation of a sinus carrier will close this chapter. Chap. 8 introduces digital modulation of a harmonic carrier, including band-limited inter-symbol interference-free transmission, matched filtering and binary shift keying of a sinusoidal carrier in amplitude (ASK), phase (PSK) or frequency (FSK). From this follows higher-order modulation schemes like M-PSK or M-QAM. A brief outlook on the functionality of channel coding and interleaving in chap. 9 will end up the lecture.
2	**Learning objectives** Aim of the Lecture: To teach the fundamentals of communications (physical layer), primarily the transmission of signals from a source to a sink, possible modulation and access methods as well as signal distortion and noise. The introduction of communications is a basement for further lectures like Communication Technology, Laboratories of Communication Technology (NTP A, B), Microwave Eng., Optical Communications, Mobile Communications and Terrestrial and satellite-based radio systems.
3	**Recommended prerequisites for participation** Deterministic Signals and Systems
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, Wi-ETiT
8	**Grade bonus compliant to §25 (2)**

9	**References** Complete Script and Literature: Pehl, E.: Digitale und analoge Nachrichtenübertragung, Hüthig, 1998; Meyer, Martin: Kommunikationstechnik, Vieweg, 1999; Stanski, B.: Kommunikationstechnik; Kammeyer, K.D.: Nachrichtenübertragung. B.G. Teubner 1996; Mäusl, R.: Digitale Modulationsverfahren. Hüthig Verlag 1995; Haykin, S.: Communication Systems. John Wiley 1994; Proakis, J., Salehi M.: Communication Systems Engineering. Prentice Hall 1994; Ziemer, R., Peterson, R.: Digital Communication. Prentice Hall 2001; Cheng, D.: Field and Wave Electromagnetics, Addision-Wesley 1992.

Courses

	Course Nr. 18-jk-1010-vl	**Course name** Fundamentals of Communications		
	Instructor Prof. Dr.-Ing. Rolf Jakoby		**Type** Lecture	**SWS** 3
	Course Nr. 18-jk-1010-ue	**Course name** Fundamentals of Communications		
	Instructor Prof. Dr.-Ing. Rolf Jakoby		**Type** Practice	**SWS** 1

Module name Computer Systems I					
Module nr. 18-hb-1020	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Christian Hochberger		

1	**Teaching content** Types of instruction sets, memory organization and its impact on the runtime, pipelining, instruction level parallelism, superscalar processors, VLIW processors, floating point numbers and operations, memory subsystem, cache types, virtual address spaces, benchmarking and performance prediction, system architecture and bus systems, peripheral devices
2	**Learning objectives** Upon successful completion of the module, students can analyze and evaluate processors, memory systems and bus systems. They can transform structures of high-level programming languages like subroutine calls into sequences of machine instructions. They are able to measure the performance of computers. They know how instructions are executed in modern processors and thus, they can predict the influence of a specific memory hierarchy onto the execution time of a given program. They know how internal and external bus systems work and can define the essential parameters for their dimension and operation.
3	**Recommended prerequisites for participation** Basic knowledge of digital design as it can be obtained by the lecture "Logic Design".
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, BSc Wi-ETiT
8	**Grade bonus compliant to §25 (2)**
9	**References** • Harris & Harris: Digital Design and Computer Architecture • Hennessy/Patterson: Computer architecture - a quantitative approach

Courses

	Course Nr. 18-hb-1020-vl	**Course name** Computer Systems I		
	Instructor Prof. Dr.-Ing. Christian Hochberger		**Type** Lecture	**SWS** 3

	Course Nr. 18-hb-1020-ue	**Course name** Computer Systems I		
	Instructor Prof. Dr.-Ing. Christian Hochberger		**Type** Practice	**SWS** 1

Module name Electronics Lab					
Module nr. 18-ho-1030	**Credit points** 3 CP	**Workload** 90 h	**Self study** 60 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Klaus Hofmann		

1	**Teaching content** Lab experiments on: • Digital Circuits: FPGA programming • Analog Ciruits: Basic Components, Amplifiers, Operational Amplifiers, Filters and Demodulators
2	**Learning objectives** A student is, after successful completion of this module, able to • perform measurement on operational amplifier circuits in the time- and frequency domain using an oscilloscope • design a traffic light controller using state diagrams and download the program to a FPGA,
3	**Recommended prerequisites for participation** Basics of Electrical Engineering; Lecture "Electronics" which is running in parallel
4	**Form of examination** Module exam: • Module exam (Study achievement, Examination, Duration: 60 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Study achievement, Examination, Weighting: 100 %)
7	**Usability of the module** BSc ETiT, WI-ETiT
8	**Grade bonus compliant to §25 (2)**
9	**References** Slide Copies of Lecture "Electronics"; Richard Jaeger: Microelectronic Circuit Design

Courses

	Course Nr. 18-ho-1011-pr	**Course name** Electronics Lab		
	Instructor M.Sc. Ferdinand Keil, Prof. Dr.-Ing. Klaus Hofmann		**Type** Internship	**SWS** 2
	Course Nr. 18-ho-1030-ev	**Course name** Electronics Lab - Introductory Meeting		
	Instructor Prof. Dr.-Ing. Klaus Hofmann		**Type** Introductory course	**SWS** 0

Module name General Computer Science II					
Module nr. 20-00-0290	**Credit points** 5 CP	**Workload** 150 h	**Self study** 90 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Prof. Dr. rer. nat. Karsten Weihe		

1	**Teaching content** In this course, students learn fundamental algorithms and data structures using advanced concepts of the programming language Java. Recapitulation Basic Java: * Variables, Types, Classes, Program Flow * Inheritance, Abstract Classes, Interfaces * Arrays and Collections Advanced Programming Concepts * Graphical User Interfaces * Input/Output * Error Handling and Exceptions Algorithms and Data Structures * Recursion * Sorting algorithms * Stacks, Lists, Queues, * Search * Trees and Graphs
2	**Learning objectives** After completion of this course, students are able to - write larger programs in Java - use fundamental algorithms and data structures of computer science - estimate and compare the quality of elementary algorithms with respect to complexity and run-time
3	**Recommended prerequisites for participation** General Computer Science I or - elementary programming skills in Java - basic knowledge in computer science - working with computers
4	**Form of examination** Course related exam: • [20-00-0290-iv] (Technical examination, Oral/written examination, Default RS)
5	**Prerequisite for the award of credit points** Pass exam (100%)
6	**Grading** Course related exam: • [20-00-0290-iv] (Technical examination, Oral/written examination, Weighting: 100 %)
7	**Usability of the module**
8	**Grade bonus compliant to §25 (2)**
9	**References**

Java lernen mit BlueJ: Eine Einführung in die objektorientierte Programmierung David J. Barnes, Michael Kölling Pearson Studium 4., aktualisierte Auflage, 2009
ISBN-13: 978-3-8689-4001-5

Algorithmen in Java
Robert Sedgewick
Pearson Studium
3. überarbeitete Auflage, 2003
ISBN-13: 978-3-8273-7072-3

Einführung in die Programmierung mit Java Robert Sedgewick, Kevin Wayne Pearson Studium 1. Auflage, 2011
ISBN-13: 978-3-8689-4076-3

Courses

Course Nr.	**Course name**		
20-00-0290-iv	General Computer Science II		
Instructor		**Type**	**SWS**
		Integrated course	4

Module name Mechatronics Workshop					
Module nr. 18-bi-1050	**Credit points** 2 CP	**Workload** 60 h	**Self study** 45 h	**Module duration** 1 Term	**Module cycle** Every Semester
Language German			**Module owner** Prof. Dr. techn. Dr.h.c. Andreas Binder		

1 Teaching content

During the mechatronic workshop students get the possibility to design and construct their own fixture, which contains a ball track and a ball elevator mechanism. Herefore dimensional plans have to be understood correctly. Afterwards all components (i.e. circuit board, rails and holders) have to be designed and manufactured within the electronic lab and the workshop, where students work independently with turning, drilling and milling machines.
The mechatronic workshop allows students to gain practical experience and knowledge in contruction, assembling and PCB layout design.

2 Learning objectives

Understanding of construction plans, circuit layout design, practical experience with turning, drilling and milling machines.

3 Recommended prerequisites for participation

You have to bring your **own printed** copy of the script. This is mandatory for attending the course. The script will be published on the moodle platform.

4 Form of examination

Module exam:

- Module exam (Study achievement, Optional, Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Study achievement, Optional, Weighting: 100 %)

7 Usability of the module

BSc/MSc ETiT, BSc/MSc MEC

8 Grade bonus compliant to §25 (2)

9 References

- Lecture Notes „Mechatronics Workshop“
- J. Dillinger et al.: Fachkunde Metall, Europa-Lehrmittel, 2007
- U. Tietze, C. Schenk, E. Gamm: Halbleiter-Schaltungstechnik, Springer, 2012

Courses

Course Nr.	**Course name**		
18-bi-1050-pr	Mechatronics Workshop		
Instructor		**Type**	**SWS**
Prof. Dr. techn. Dr.h.c. Andreas Binder		Internship	1

Module name Laboratory Matlab/Simulink I					
Module nr. 18-ko-1030	**Credit points** 3 CP	**Workload** 90 h	**Self study** 45 h	**Module duration** 1 Term	**Module cycle** Every Semester
Language German			**Module owner** Prof. Dr.-Ing. Ulrich Konigorski		

1	**Teaching content** In this lab tutorial, an introduction to the software tool MatLab/Simulink will be given. The lab is split into two parts. First the fundamentals of programming in Matlab are introduced and their application to different problems is trained. In addition, an introduction to the Control System Toolbox will be given. In the second part, the knowledge gained in the first part is applied to solve a control engineering specific problem with the software tools.
2	**Learning objectives** Fundamentals in the handling of Matlab/Simulink and the application to control engineering tasks.
3	**Recommended prerequisites for participation** The lab should be attended in parallel or after the lecture “System Dynamics and Control Systems I”
4	**Form of examination** Module exam: • Module exam (Study achievement, Optional, Default RS)
5	**Prerequisite for the award of credit points** Passing the final module examination
6	**Grading** Module exam: • Module exam (Study achievement, Optional, Weighting: 100 %)
7	**Usability of the module** BSc ETiT; BSc MEC
8	**Grade bonus compliant to §25 (2)** In case of E-Learning: Possibility to improve the grade up to 1,0
9	**References** • Lecture notes for the lab tutorial can be obtained at the secretariat • Lunze; Regelungstechnik I • Dorp; Bishop: Moderne Regelungssysteme • Moler: Numerical Computing with MATLAB

Courses

Course Nr.	Course name		
18-ko-1030-pr	Laboratory Matlab/Simulink I		
Instructor		**Type**	**SWS**
M.Sc. Alexander Steinke, Prof. Dr.-Ing. Ulrich Konigorski		Internship	3

Module name Microelectronic Devices					
Module nr. 18-pr-1030	**Credit points** 4 CP	**Workload** 120 h	**Self study** 75 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr. rer. nat. Sascha Preu		

1 Teaching content

1. Introduction: Semiconductor Devices & Microelectronic
2. Semiconductor: Materials, Physics & Technology
3. PN-Junction
4. Metal-Oxide-Semiconductor Capacity
5. Schottky Contact
6. MOS-Field-Effect-Transistor (MOSFET)
7. CMOS: Digital Applications
8. MOS-Memory
9. Bipolar- Junction-Transistor
10. Outlook: Scaling Limits & SET,...

2 Learning objectives

- Understand the physical properties and processes in semiconductor devices and materials
- the operation of basic semiconductor devices like diode, MOS-Transistor and bipolar transistor
- Understand functionality of basic circuits like rectifier circuit , 1-transistor amplifier and inverter from the device point of view.
- Goal: Understand state-of-the art semiconductor devices and circuits as a basis for a successful engineering career

3 Recommended prerequisites for participation

Electrical Engineering and Information Technology I, Electrical Engineering and Information Technology II, Laboratory ETiT, Laboratory Electronics, Mathematics I, Mathematics II, Physics

4 Form of examination

Module exam:

- Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Examination, Weighting: 100 %)

7 Usability of the module

BSc ETiT

8 Grade bonus compliant to §25 (2)

9 References

Skript: Microelectronic devices - the Basics

1. Robert F. Pierret: Semiconductor Device Fundamentals, ISBN 0201543931
2. Roger T. How, Charles G. Sodini: Microelectronics - an Integrated Approach, ISBN 0135885183
3. Richard C. Jaeger: Microelectronic Circuit Design, ISBN 0071143866
4. Y. Taur, T.H. Ning, Fundamentals of Modern VLSI Devices, ISBN 0521559596
5. Thomas Tille, Doris Schmidt-Landsiedel: Mikroelektronik, ISBN 3540204229
6. Michael Reisch: Halbleiter-Bauelemente, ISBN 3540213848

Courses

Course Nr.	**Course name**		
18-pr-1030-vl	Microelectronic Devices		
Instructor		**Type**	**SWS**
Prof. Dr. rer. nat. Sascha Preu		Lecture	2

Course Nr.	**Course name**		
18-pr-1030-ue	Microelectronic Devices		
Instructor		**Type**	**SWS**
Prof. Dr. rer. nat. Sascha Preu		Practice	1

Module name Modelling and simulation of circuits					
Module nr. 18-sc-2010	**Credit points** 4 CP	**Workload** 120 h	**Self study** 75 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German/English			**Module owner** Prof. Dr. rer. nat. Sebastian Schöps		

1 Teaching content

The content of this course is the following:

- Circuit interpretation as directed graphs
- Modified nodal and loop analysis
- Flux and charge oriented formulations
- Differential algebraic equations
- Linear system solver
- Numerical solution of nonlinear systems
- Time-domain methods
- Frequency-domain solution
- Implementation of the numerical methods

2 Learning objectives

Students understand the theoretical and numerical fundamentals of circuit simulation and how the equations can be derived from Maxwell's equations. Circuit properties can be expressed in tems of graph theory. The sparse systems of equations such as the flux/charge oreinted modified nodal analysis can be assembled. In order to solve the obtained systems, different numerical methods for the simulation of circuits are relevant. This includes methods for the solution of linear systems (direct and iterative solvers), root-finding algorithms for nonlinear systems and implicit time integration methods. Mathematical concepts such as stability, convergence order or complexity are known and can be employed to judge the advantages and disadvantages of the various methods. Eventually, the students are able to programm their own circuit simulator, that can return both frequency as well as time domain solutions of electric networks.

3 Recommended prerequisites for participation

18-hs-1070 Elektrotechnik und Informationstechnik I, 18-gt-1020 Elektrotechnik und Informationstechnik II, 20-00-0304 Allgemeine Informatik I, 04-10-0602 Statistics/Probability Theory, 04-10-0603 Scientific Computing

4 Form of examination

Module exam:

- Module exam (Technical examination, Oral examination, Duration: 20 Min., Default RS)

5 Prerequisite for the award of credit points

Passing the final module examination

6 Grading

Module exam:

- Module exam (Technical examination, Oral examination, Weighting: 100 %)

7 Usability of the module

BSc/MSc etit, BSc/MSc iST, BSc MEC, MSc iCE, MSc WI-etit

8 Grade bonus compliant to §25 (2)

Grade bonus of 0,4 if correctly implemented programs are submitted

9 References

- L. W. Nagel, “SPICE2: A computer program to simulate semiconductor circuits”, University of Berkeley, Tech. Rep., 1975.
- C.-W. Ho, A. E. Ruehli, and P. A. Brennan, “The modified nodal approach to network analysis”, IEEE Trans. Circ. Syst., vol. 22, no. 6, pp. 504-509, Jun. 1975.
- J. Vlach, K. Singhal, Computer methods for circuit analysis and design. New York : Van Nostrand Reinold, 1983.

Courses

Course Nr. 18-sc-2010-vl	**Course name** Modelling and simulation of circuits		
Instructor		**Type** Lecture	**SWS** 2

Course Nr. 18-sc-2010-ue	**Course name** Modelling and simulation of circuits		
Instructor		**Type** Practice	**SWS** 1

5.2 Optional Catalog MB: Mechanical Engineering

Module name Design of Human-Machine-Interfaces					
Module nr. 16-21-5040	**Credit points** 6 CP	**Workload** 180 h	**Self study** 120 h	**Module duration** 1 Term	**Module cycle** Every 2. Semester
Language German			**Module owner** Dr. Ing. Bettina Abendroth		

1	**Teaching content** Case studies of human-machine-interfaces, basics of system theory, user modelling, human-machine-interaction, interface-design, usability.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Reflect the technical development of human-machine interfaces using examples. 2. Describe human-machine interfaces in system theoretical terminology. 3. Explain models of human information processing and the related application issues. 4. Apply the human-centered product development process in accordance with DIN EN ISO 9241-210. 5. Analyse the use context of products for the deduction of user requirements. 6. Implement the design criterias using the guidelines for the design of human-machine systems 7. Assess the usability of products using methods with and without user involvement.
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS) Written exam 90 min
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** WP Bachelor MB Bachelor Mechatronik
8	**Grade bonus compliant to §25 (2)**
9	**References** Lecture notes available on the internet (www.arbeitswissenschaft.de)

Courses

Course Nr. 16-21-5040-vl	**Course name** Design of Human-Machine-Interfaces		
Instructor		**Type** Lecture	**SWS** 3

	Course Nr. 16-21-5040-ue	**Course name** Design of Human-Machine-Interfaces		
	Instructor		**Type** Practice	**SWS** 1

Module name Fundamentals of Turbomachinery and Fluid Systems					
Module nr. 16-10-5100	**Credit points** 8 CP	**Workload** 240 h	**Self study** 180 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Peter Pelz		

1	**Teaching content** Application of the conservation equations to engineering fluid systems; Transmission behavior; Linearization; Resilience; Compressibilty; Effective speed of sound; Two phase flows; Flexible pipes; Pneumatic spring; Pressure reservoir; Resistance laws; Darcy medium; Porosity; Sorption processes; Bingham medium; Stability of suspensions; Electro- and magneto-rheological fluids; Visco-elastic fluids; Hydraulic pistons; Inertia losses; Friction losses; Efficiency; Transient flows; Hydraulic bearings; Virtual/Added masses; Method of characteristics; Resonance charging of combustion engines; Shock losses; Dimensional analysis; Fluid energy machines; Characteristic curve; Operating point; Instabilities; Acoustics
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Assess pneumatic as well as hydraulic fluid systems. 2. Describe the flow through valves, filters and seals. 3. Use the Cordier diagram in oder to select the most energy efficient fluid flow machine. 4. Describe the dynamic behaviour of fluid systems. 5. Describe the essential losses and operation limits of fluid flow machines. 6. Characterize non-Newtonian materials in its temperature behaviour. 7. Describe compressible, unsteady flows by the aid of the linear method of characteristics.
3	**Recommended prerequisites for participation** Fundamental fluid mechanics recommended
4	**Form of examination** Module exam: • Module exam (Technical examination, Optional, Default RS) Written exam 90 min or oral exam 30 min Will be announced at the beginning of the term depending on the circumstances (number of students, pandemic etc.).
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Optional, Weighting: 100 %)
7	**Usability of the module** WP Bachelor MB
8	**Grade bonus compliant to §25 (2)**
9	**References** Study material available at www.fst.tu-darmstadt.de. Recommended books: Wylie; Streeter: Fluid Transients in Systems, Prentice Hall. Spurk, Josef: Strömungslehre, Springer Verlag. Betz: Einführung in die Theorie der der Strömungsmaschinen, Braun. Brennen: Hydrodynamics of Pumps, Oxford University Press.
Courses	

	Course Nr. 16-10-5100-vl	**Course name** Fundamentals of Turbomachinery and Fluid Systems		
	Instructor		**Type** Lecture	**SWS** 4

Module name Motor Vehicles					
Module nr. 16-27-5010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 105 h	**Module duration** 1 Term	**Module cycle** Summer term
Language German			**Module owner** Prof. Dr.-Ing. Steven Peters		

1	**Teaching content** Layout and function of vehicle components (e.g. engine, transmission, chassis, tires, breaks, steering); driving resistance & performance; safety; aerodynamics and automotive computing.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Calculate the factors that influence fuel consumption and discuss the strategies to reduce fuel consumption. 2. Derive upper bounds for combustion engine efficiencies and discuss the future opportunities & challenges of electromobility. 3. Explain the basic requirements, working principles, and basic structure of the drivetrain, powertrain, and chassis assemblies (including tires, wheels, brakes, steering, springs, dampers and axles). 4. Name and explain the methods to increase safety in individual traffic. 5. Explain the effects of aerodynamic measures on driving dynamics and fuel consumption.
3	**Recommended prerequisites for participation** Basic knowledge of technical mechanics (force diagram, equations of motion) and basic knowledge of thermodynamics recommended.
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** WP Bachelor MB Bachelor Mechatronik MSc. Informatik (Anwendungsfach Fahrzeugtechnik, Spezialisierung)
8	**Grade bonus compliant to §25 (2)**
9	**References** Manuscript, CD-ROM (can be purchased at the department's office), internet download

Courses

Course Nr.	**Course name**		
16-27-5010-vl	Motor Vehicles		
Instructor		**Type** Lecture	**SWS** 3

	Course Nr. 16-27-5010-ue	**Course name** Motor Vehicles		
	Instructor		**Type** Practice	**SWS** 2

Module name
Fundamental Fluid Mechanics

Module nr.	Credit points	Workload	Self study	Module duration	Module cycle
16-11-5010	6 CP	180 h	120 h	1 Term	Summer term

Language	Module owner
German	Prof. Dr.-Ing. Jeanette Hussong

1 Teaching content
Properties of fluids, flow kinematics, conservation equations, constitutive equations, equations of motion, Navier-Stokes equations, hydrostatics, exact solutions, turbulent flows, stream filament theory, flow around bodies.

2 Learning objectives
On successful completion of this module, students should be able to:
1. Explain the origins and limitations of the basic conservation equations of fluid mechanics (mass, momentum, moment of momentum, energy).
2. Choose the correct equations, simplifications, and boundary conditions for a given application and recognise avenues for solution.
3. Use stream filament theory and loss coefficients to compute flow networks. These capabilities are developed for incompressible, single phase flows.

3 Recommended prerequisites for participation
Knowledge of ordinary and partial differential equations recommended

4 Form of examination
Module exam:
- Module exam (Technical examination, Examination, Duration: 150 Min., Default RS)

5 Prerequisite for the award of credit points
Passing the examination

6 Grading
Module exam:
- Module exam (Technical examination, Examination, Weighting: 100 %)

7 Usability of the module
Bachelor MB Pflicht
Master ETiT AUT; Bachelor Mechatronik

8 Grade bonus compliant to §25 (2)

9 References
Spurk: Strömungslehre, Springer Verlag.
Spurk: Aufgaben zur Strömungslehre, Springer Verlag.

Courses

Course Nr.	Course name	Instructor	Type	SWS
16-11-5010-vl	Fundamental Fluid Mechanics		Lecture	3
16-11-5010-ue	Fundamental Fluid Mechanics		Practice	1

Module name
Technical Thermodynamics II

Module nr.	Credit points	Workload	Self study	Module duration	Module cycle
16-14-5020	2 CP	60 h	45 h	1 Term	Summer term

Language	Module owner
German	Prof. Dr.-Ing. Peter Stephan

1 Teaching content
Properties of ideal gas mixtures and mixing processes; moist air and air-conditioning processes; thermodynamic analysis of complete and incomplete combustion processes including air demand; exhaust gas composition, caloric value, and energy balances.

2 Learning objectives
On successful completion of this module, students should be able to:

1. Transfer his knowledge from Technical Thermodynamics I on pure gases to gas mixtures and analyse corresponding processes.
2. Describe all states of moist air with all forms of aggregate states.
3. Calculate the change of state of moist air in air-conditioning processes.
4. Set up the main reactions equations for combustion processes and derive from them the air demand and exhaust gas composition for different fuels.
5. Set up the energy balance for combustion processes and calculate the generated heat transfer.

3 Recommended prerequisites for participation
Technical Thermodynamics I recommended

4 Form of examination
Module exam:
- Module exam (Technical examination, Technical examination, Default RS)

Written exam 90 min

5 Prerequisite for the award of credit points
Passing the examination

6 Grading
Module exam:
- Module exam (Technical examination, Technical examination, Weighting: 100 %)

7 Usability of the module
Bachelor MPE Pflicht
Bachelor Mechatronik

8 Grade bonus compliant to §25 (2)

9 References
P. Stephan; K. Schaber; K. Stephan; F. Mayinger: Thermodynamik, Band 2: Mehrstoffsysteme, Springer Verlag.
Further material (slides, collection of exercises, table of fomulas etc.) is available through the Moodle system of TU Darmstadt.

Courses

Course Nr.	Course name		
16-14-5020-vl	Technical Thermodynamics II		
Instructor		**Type**	**SWS**
		Lecture	1

	Course Nr. 16-14-5020-gü	**Course name** Technical Thermodynamics II - Group Exercise		
	Instructor		**Type** Group practice	**SWS** 0
	Course Nr. 16-14-5020-hü	**Course name** Technical Thermodynamics II		
	Instructor		**Type** Lecture hall practice	**SWS** 0

Module name Production Technology					
Module nr. 16-09-5010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 135 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Peter Groche		

1	**Teaching content** Manufacturing of components by forming and machining, erosion and welding, as well as machining in general.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. List all industrial production techniques in the metal and plastics manufacturing area. 2. Follow through with a systematic comparison of alternative production methods. 3. Optimize the production of industrially manufactured products, i.e. to develop alternative manufactured process chains. 4. Form products appropriate for manufacturing and assembly.
3	**Recommended prerequisites for participation** None
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 120 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** Bachelor MB Pflicht Bachelor WI-MB Bachelor Mechatronik
8	**Grade bonus compliant to §25 (2)**
9	**References** Lecture notes are available during the course.

Courses

Course Nr.	**Course name**		
16-09-5010-vl	Production Technology		
Instructor		**Type** Lecture	**SWS** 3

Module name Combustion Engines I					
Module nr. 16-03-5010	**Credit points** 6 CP	**Workload** 180 h	**Self study** 135 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr. techn. Christian Beidl		

1	**Teaching content** Introduction: Historic review, economic and ecological aspects, classification of engines. Fundamentals of the thermodynamic process: Carnot cycle, constant-volume cycle, constant-pressure cycle, Seiliger cycle. Fundamentals of engine construction: Crank shaft, con-rod, bearing, piston, piston rings, piston pin, liner, cylinder head gasket, cylinder head, charge cycle. Parameters: Mean pressure, power, torque, fuel consumption, efficiency, cylinder charge, air fuel ratio, kinematics of the crank mechanism, compression ratio, characteristic diagrams, main dimensions. Fuel: Chemical configuration, characteristics, heat value, characteristics of ignition, production, alternative fuels. Basics of carburation: Spark-ignition engines, diesel engines, spreading, conditioning. Carburation of spark-ignition engines: Carburator, electronic fuel injection, HCCI (Homogeneous Charge Compression Ignition). Ignition of spark-ignition engines: Requirements, spark plug, ignition systems, magnetic systems, knock control systems.Mixture formation of diesel engines: basics, classification of different methods, mixture distribution and mixture formation, injection systems.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. Explain the principles and the construction of combustion engines (ranging from small two-stroke models to the marine diesel engine). 2. Explain the physical principles of combustion engines. 3. Develop the essential parameters and apply these to characterise engines. 4. Explain the economic and ecological relevance of combustion engines. 5. Apply the thermodynamic basics of combustion engines to develop new drive concepts. 6. Describe the basics of the engine construction. 7. Analyse and evaluate the interdependency of fuel, mixture formation, and combustion. 8. Explain the difference by mixture formation and ignition process of spark ignited engines and diesel engines. 9. Explain the ignition and ignition systems of the spark ignited engine.
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Technical examination, Default RS) Written or oral exam [written: 90 min; oral: 90 min (per group with 4 people 22,5 min per participiant). Will be announced at the beginning of the term depending on the circumstances (number of students, pandemic etc.).
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Technical examination, Weighting: 100 %)
7	**Usability of the module**

	WP Bachelor MB Bachelor Mechatronik			
8	**Grade bonus compliant to §25 (2)**			
9	**References** VKM I - script, available at the secretariat			
Courses				
	Course Nr. 16-03-5010-vl	**Course name** Combustion Engines I		
	Instructor		**Type** Lecture	**SWS** 3

Module name Machine Tools and Industrial Robots					
Module nr. 16-09-5020	**Credit points** 8 CP	**Workload** 240 h	**Self study** 180 h	**Module duration** 1 Term	**Module cycle** Winter term
Language German			**Module owner** Prof. Dr.-Ing. Matthias Weigold		

1	**Teaching content** The course content includies machining theory, design of machine tools, machine tool components (basements, guideways, bearings, drives, controls), CAD-CAM process-chain, aspects concerning economy, construction of industrial robots.
2	**Learning objectives** On successful completion of this module, students should be able to: 1. List the machining production methods and to explain their operation mode. 2. Describe the composition of machine tools. 3. Evalute and to specify the individual elements of a machine tool and therefore develop concepts of machine tools and industrial robots. 4. Explain the function of the elements machine bed, guideways and bearings, drives and nc-controls, measuring systems, main spindle as well as workpiece and tool handling.
3	**Recommended prerequisites for participation**
4	**Form of examination** Module exam: • Module exam (Technical examination, Examination, Duration: 90 Min., Default RS)
5	**Prerequisite for the award of credit points** Passing the examination
6	**Grading** Module exam: • Module exam (Technical examination, Examination, Weighting: 100 %)
7	**Usability of the module** WP Bachelor MB Bachelor Mechatronik
8	**Grade bonus compliant to §25 (2)**
9	**References** Lecture notes are available during the course and in PTW's secretariat.

Courses

Course Nr. 16-09-5020-vl	**Course name** Machine Tools and Industrial Robots		
Instructor		**Type** Lecture	**SWS** 4