Modules of Mechanical Engineering for Exchange Students

Valid from Winter Term 2019/2020

Date: 17.09.2019

KIT DEPARTMENT OF MECHANICAL ENGINEERING

Table Of Contents

1 Field of study structure

Mandatory	
KIT-Department of Mechanical Engineering Courses	90 CR
Courses of Other Faculties and Soft Skills	90 CR

1.1 KIT-Department of Mechanical Engineering Courses

Credits
90

Election block: Leistungen der KIT-Fakultät Maschinenbau ()		
M-MACH-104847	Major Field Fundamentals of Engineering	60 CR
M-MACH-104848	Major Field Energy and Environmental Engineering	90 CR
M-MACH-104849	Major Field Automotive Engineering	90 CR
M-MACH-104850	Major Field Mechatronics and Microsystem Technology	90 CR
M-MACH-104851	Major Field Product Development and Construction	90 CR
M-MACH-104852	Major Field Production Technology	90 CR
M-MACH-104853	Major Field Theoretical Foundations of Mechanical Engineering	90 CR
M-MACH-104854	Major Field Materials and Structures for High Performance Systems	90 CR
M-MACH-104878	Specification in Mechanical Engineering	60 CR
M-MACH-105134	Elective Module Mechanical Engineering	60 CR

1.2 Courses of Other Faculties and Soft Skills

Credits
90

Election block: Leistungen anderer KIT-Fakultäten und Überfachliche Qualifikationen ()		
M-MACH-104882	Courses of the Department of Electrical Engineering and Information Technology	90 CR
M-MACH-104883	Courses of the Department of Informatics	30 CR
M-MACH-104884	Courses of the Department of Economics and Management	20 CR
M-MACH-104885	Courses of the Department of Mathematics	10 CR
M-MACH-105100	Courses of the Department of Chemical and Process Engineering	4 CR

2 Modules

M 2.1 Module: Courses of the Department of Chemical and Process Engineering [M-MACH-105100]

Organisation: KIT Department of Mechanical Engineering
Part of: Courses of Other Faculties and Soft Skills

Credits	Language	Level	Version
4	English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_CIW (between 0 and 90 credits)			
T-CIWVT-110307	Chemical Fuels	6 CR	Rauch

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to reconstruct selected topics of Mathematics.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.2 Module: Courses of the Department of Economics and Management [M-MACH-104884]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: Courses of Other Faculties and Soft Skills

Credits	Language	Level	Version
20	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_WIWI (between 0 and 90 credits)			
T-WIWI-102758	Introduction to Operations Research I and II	9 CR	Nickel, Rebennack, Stein
T-WIWI-107501	Energy Market Engineering	4,5 CR	Weinhardt
T-WIWI-102864	Entrepreneurship	3 CR	Terzidis
T-WIWI-102900	Financial Analysis	4,5 CR	Luedecke
T-WIWI-102870	Logistics and Supply Chain Management	3,5 CR	Wiens
T-WIWI-102800	Management Accounting 1	4,5 CR	Wouters
T-WIWI-109864	Product and Innovation Management	3 CR	Klarmann
T-WIWI-103091	Production and Logistics Controlling	3 CR	Rausch
T-WIWI-100806	Renewable Energy-Resources, Technologies and Economics	4 CR	Jochem, McKenna
T-WIWI-102629	Management and Strategy	3,5 CR	Lindstädt

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to reconstruct selected topics of Economics and Management.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.3 Module: Courses of the Department of Electrical Engineering and Information Technology [M-MACH-104882]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: Courses of Other Faculties and Soft Skills

Credits	Language	Level	Version
90	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_ETIT (between 0 and 90 credits)			
T-ETIT-101930	Medical Imaging Techniques I	3 CR	Dössel
T-ETIT-101931	Medical Imaging Techniques II	3 CR	Dössel
T-ETIT-101956	Bioelectric Signals	3 CR	Loewe
T-ETIT-106492	Biomedical Measurement Techniques I	3 CR	Nahm
T-ETIT-101918	Digital Technology	6 CR	Becker
T-ETIT-100807	Electrical Machines	4 CR	Becker
T-ETIT-101954	Electrical Machines and Power Electronics	6 CR	Becker
T-ETIT-101923	Electric Energy Systems	5 CR	Leibfried
T-ETIT-109318	Electronic Devices and Circuits	6 CR	Siegel
T-ETIT-108386	Electrical Engineering and Electronics	8 CR	Becker
T-ETIT-100784	Hybrid and Electric Vehicles	4 CR	Becker
T-ETIT-100694	Methods of Signal Processing	6 CR	Puente León
T-ETIT-101939	Photovoltaics	6 CR	Powalla
T-ETIT-108344	Seminar Novel Concepts for Solar Energy Harvesting	3 CR	Richards
T-ETIT-109313	Signals and Systems	6 CR	Puente León
T-ETIT-106970	Superconducting Materials for Energy Applications	4 CR	Grilli
T-ETIT-101921	System Dynamics and Control Engineering	6 CR	Hohmann
T-ETIT-100677	Systems Engineering for Automotive Electronics	4 CR	Bortolazzi
T-ETIT-101952	Theory of Probability	5 CR	Jäkel

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to reconstruct selected topics of Electrical Engineering and Information Technology.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.4 Module: Courses of the Department of Informatics [M-MACH-104883]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: Courses of Other Faculties and Soft Skills

Credits	Language	Level	Version
30	German/English	4	1

Election notes

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_INFO (between 0 and 90 credits)			
T-INFO-101466	Information Processing in Sensor Networks	6 CR	Hanebeck
T-INFO-101356	Cognitive Systems	6 CR	Dillmann, Waibel
T-INFO-101377	Localization of Mobile Agents	6 CR	Hanebeck
T-INFO-101266	Human-Machine-Interaction	6 CR	Beigl
T-INFO-101310	Patent Law	3 CR	Dreier
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-INFO-105723	Robotics II: Humanoid Robotics	3 CR	Asfour
T-INFO-109931	Robotics III - Sensors and Perception in Robotics	3 CR	Asfour
T-INFO-101357	Medical Robotics	3 CR	Kröger, Mathis-Ullrich

Competence Certificate

Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal

The students are able to reconstruct selected topics of Informatics.

Prerequisites

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content

See individual bricks

M 2.5 Module: Courses of the Department of Mathematics [M-MACH-104885]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: Courses of Other Faculties and Soft Skills

Credits	Language	Level	Version
10	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_MATH (between 0 and 90 credits)			
T-MATH-102242	Numerical Mathematics for Students of Computer Science	6 CR	Rieder, Weiß, Wieners
T-MATH-109620	Probability Theory and Statistics	5 CR	Hug

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
The students are able to reconstruct selected topics of Mathematics.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.6 Module: Elective Module Mechanical Engineering [M-MACH-105134]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Prof. Dr.-Ing. Martin Heilmaier

Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
60	German/English	4	1

Election notes

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Wahlbereich A ()			
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-105407	CFD in Power Engineering	4 CR	Otic
T-MACH-109302	Computational Homogenization on Digital Image Data	6 CR	Schneider
T-MACH-106698	A holistic approach to power plant management	4 CR	Seidl, Stieglitz
T-MACH-108407	NMR micro probe hardware conception and construction	4 CR	Korvink
T-MACH-110431	Digital microstructure characterization and modeling	6 CR	Schneider
T-MACH-105444	Combined Cycle Power Plants	4 CR	Schulenberg
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-105530	Fundamentals of reactor safety for the operation and dismantling of nuclear power plants	4 CR	Sanchez-Espinoza
T-MACH-105162	Fundamentals of Automobile Development I	2 CR	Frech
T-MACH-105163	Fundamentals of Automobile Development II	2 CR	Frech
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-109185	Innvative Project	6 CR	Class, Terzidis
T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation	4 CR	Dagan
T-MACH-105402	Nuclear Power Plant Technology	4 CR	Badea, Cheng, Schulenberg
T-MACH-105410	Coal Fired Power Plants	4 CR	Schulenberg
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-105782	Micro Magnetic Resonannce	4 CR	Korvink, MacKinnon
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-108383	Microsystem Simulation	4 CR	Korvink
T-MACH-105532	Nonlinear Continuum Mechanics	5 CR	Böhlke
T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications	4 CR	Worgull
T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications	4 CR	Rapp
T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics	4 CR	Rapp, Worgull
T-MACH-107447	Reliability Engineering 1	3 CR	Konnov
T-MACH-105445	Simulator Exercises Combined Cycle Power Plants	2 CR	Schulenberg
T-MACH-105456	Ten Lectures on Turbulence	4 CR	Otic
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer

T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-105554	Thin Film and Small-scale Mechanical Behavior	4 CR	Gruber, Schwaiger, Weygand
T-MACH-102206	Vehicle Ride Comfort & Acoustics I	3 CR	Gauterin
T-MACH-102205	Vehicle Ride Comfort & Acoustics II	3 CR	Gauterin
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova
T-MACH-102124	Virtual Engineering II	4 CR	Ovtcharova
T-MACH-105529	Heat Transfer in Nuclear Reactors	4 CR	Cheng
Election block: Wahlbereich B ()			
T-MACH-102141	Constitution and Properties of Wearresistant Materials	4 CR	Ulrich
T-MACH-105528	Aerodynamics	4 CR	Frohnapfel, Ohle
T-MACH-105451	Drive Systems and Possibilities to Increase Efficiency	2 CR	Kollmeier
T-MACH-105530	Fundamentals of reactor safety for the operation and dismantling of nuclear power plants	4 CR	Sanchez-Espinoza
T-MACH-105786	Contact Mechanics	4 CR	Greiner
T-MACH-106700	Do it! – Service-Learning for prospective mechanical engineers	2 CR	Deml
T-MACH-108374	Vehicle Ergonomics	4 CR	Heine
T-INFO-101262	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	3 CR	Dillmann, Spetzger
T-MACH-106746	Hands-on BioMEMS	4 CR	Guber
T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle	2 CR	Dagan
T-MACH-105235	Principles of Medicine for Engineers	4 CR	Pylatiuk
T-MACH-106493	Solar Thermal Energy Systems	4 CR	Dagan
T-MACH-105574	Mechatronical Systems and Products	3 CR	Hohmann, Matthiesen
T-MACH-106707	Workshop on computer-based flow measurement techniques	4 CR	Bauer
T-MACH-106747	Neurovascular Interventions (BioMEMS V)	4 CR	Cattaneo, Guber
T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications	4 CR	Gengenbach, Hagenmeyer, Koker, Sieber
T-MACH-105652	Fundamentals of Combustion Engine Technology	5 CR	Bernhardt, Kubach, Pfeil, Toedter, Wagner

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
In the Elective Module Mechanical Engineering, students acquire sound knowledge in engineering. With this in-depth knowledge of scientific theories, principles and methods, students can successfully deal with clearly specified problems that have a unique solution approach in mechanical engineering.

Prerequisites
none

Learning type
Lectures, tutorials

M 2.7 Module: Major Field Automotive Engineering [M-MACH-104849]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	2

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Fahrzeugtechnik ()			
T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines	4 CR	Gohl
T-MACH-105655	Alternative Powertrain for Automobiles	4 CR	Noreikat
T-MACH-105307	Drive Train of Mobile Machines	4 CR	Geimer, Wydra
T-MACH-105311	Design and Development of Mobile Machines	4 CR	Geimer, Siebert
T-MACH-108887	Design and Development of Mobile Machines - Advance	0 CR	Geimer, Siebert
T-MACH-105536	Dimensioning and Optimization of Power Train System	4 CR	Albers, Faust, Kirchner, Matthiesen
T-MACH-106424	Rail System Technology	4 CR	Gratzfeld
T-MACH-105184	Fuels and Lubricants for Combustion Engines	4 CR	Kehrwald, Kubach
T-MACH-102150	BUS-Controls	4 CR	Becker, Geimer
T-MACH-108889	BUS-Controls - Advance	0 CR	Daiß, Geimer
T-MACH-105540	Railways in the Transportation Market	4 CR	Gratzfeld
T-MACH-105226	Dynamics of the Automotive Drive Train	5 CR	Fidlin
T-MACH-102121	Electric Rail Vehicles	4 CR	Gratzfeld
T-MACH-105152	Handling Characteristics of Motor Vehicles I	4 CR	Unrau
T-MACH-105153	Handling Characteristics of Motor Vehicles II	4 CR	Unrau
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
T-MACH-105156	Vehicle Mechatronics I	4 CR	Ammon
T-MACH-102207	Tires and Wheel Development for Passenger Cars	4 CR	Leister
T-MACH-105218	Automotive Vision	6 CR	Lauer, Stiller
T-MACH-102093	Fluid Power Systems	4 CR	Geimer, Pult
T-MACH-100092	Automotive Engineering I	8 CR	Gauterin, Unrau
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau
T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment	4 CR	Deutschmann, Grunwaldt, Kubach, Lox
T-MACH-102116	Fundamentals for Design of Motor-Vehicle Bodies I	2 CR	Bardehle
T-MACH-102119	Fundamentals for Design of Motor-Vehicle Bodies II	2 CR	Bardehle
T-MACH-105160	Fundamentals in the Development of Commercial Vehicles I	2 CR	Zürn
T-MACH-105161	Fundamentals in the Development of Commercial Vehicles II	2 CR	Zürn
T-MACH-105162	Fundamentals of Automobile Development I	2 CR	Frech
T-MACH-105163	Fundamentals of Automobile Development II	2 CR	Frech
T-MACH-105375	Industrial Aerodynamics	4 CR	Breitling, Frohnapfel

T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars	4 CR	Schlichtenmayer
T-MACH-105222	Motor Vehicle Labor	4 CR	Frey
T-MACH-105168	Mobile Machines	8 CR	Geimer
T-MACH-105337	Engine Laboratory	4 CR	Wagner
T-MACH-105169	Engine Measurement Techniques	4 CR	Bernhardt
T-MACH-102155	Product, Process and Resource Integration in the Automotive Industry	4 CR	Mbang
T-MACH-102156	Project Workshop: Automotive Engineering	6 CR	Frey, Gauterin, Gießler
T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems	4 CR	Ays, Geerling
T-MACH-104599	Project Management in Rail Industry	4 CR	Gratzfeld
T-MACH-105350	Computational Vehicle Dynamics	4 CR	Proppe
T-MACH-105353	Rail Vehicle Technology	4 CR	Gratzfeld
T-MACH-105172	Simulation of Coupled Systems	4 CR	Geimer, Xiang
T-MACH-108888	Simulation of Coupled Systems - Advance	0 CR	Geimer, Xiang
T-MACH-105970	Structural Analysis of Composite Laminates	4 CR	Kärger
T-MACH-105423	Tractors	4 CR	Becker, Geimer, Kremmer
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-104609	Combustion Engines II	5 CR	Koch, Kubach
T-MACH-105367	Behaviour Generation for Vehicles	4 CR	Stiller, Werling
T-MACH-110318	Product- and Production-Concepts for modern Automobiles	4 CR	Kienzle, Steegmüller

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Automotive Engineering serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.8 Module: Major Field Energy and Environmental Engineering [M-MACH-104848]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Energie- und Umwelttechnik ()			
T-MACH-105428	Selected Chapters of the Combustion Fundamentals	4 CR	Maas
T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises	4 CR	Dagan
T-MACH-105313	CFD-Lab Using OpenFOAM	4 CR	Koch
T-MACH-105391	Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems	4 CR	Günther
T-MACH-105525	Introduction to Nuclear Energy	4 CR	Cheng
T-MACH-102211	Energy and Process Technology I	9 CR	Bauer, Schwitzke, Velji, Wirbser
T-MACH-102212	Energy and Process Technology II	9 CR	Schwitzke, Wirbser
T-MACH-105715	Energy demand of buildings – fundamentals and applications, with building simulation exercises	6 CR	Schmidt
T-MACH-105952	Energy Storage and Network Integration	4 CR	Jäger, Stieglitz
T-MACH-105408	Energy Systems I: Renewable Energy	6 CR	Dagan
T-MACH-105550	Energy systems II: Reactor Physics	4 CR	Badea
T-MACH-105564	Energy Conversion and Increased Efficiency in Internal Combustion Engines	4 CR	Koch, Kubach
T-MACH-105512	Experimental Fluid Mechanics	4 CR	Kriegseis
T-MACH-105411	Fusion Technology A	4 CR	Stieglitz
T-MACH-105433	Fusion Technology B	4 CR	Stieglitz
T-MACH-105533	Gasdynamics	4 CR	Magagnato
T-MACH-105220	Fundamentals of Energy Technology	8 CR	Badea, Cheng
T-MACH-105326	Hydraulic Fluid Machinery	8 CR	Pritz
T-MACH-105404	Innovative Nuclear Systems	4 CR	Cheng
T-MACH-105414	Cooling of Thermally High Loaded Gas Turbine Components	4 CR	Bauer, Schulz
T-MACH-105331	Laboratory Exercise in Energy Technology	4 CR	Bauer, Maas, Wirbser
T-MACH-105426	Magnetohydrodynamics	4 CR	Bühler
T-MACH-105434	Magnet Technology of Fusion Reactors	4 CR	Fietz, Weiss
T-MACH-105419	Mathematical Models and Methods in Combustion Theory	4 CR	Bykov, Maas
T-MACH-105167	Analysis Tools for Combustion Diagnostics	4 CR	Pfeil
T-MACH-105435	Neutron Physics of Fusion Reactors	4 CR	Fischer
T-MACH-105397	Numerical Simulation of Turbulent Flows	4 CR	Grötzbach
T-MACH-105338	Numerical Fluid Mechanics	4 CR	Magagnato
T-MACH-105453	Numerical Fluid Mechanics with MATLAB	4 CR	Frohnapfel
T-MACH-105405	Reactor Safety I: Fundamentals	4 CR	Sanchez-Espinoza

T-MACH-105421	Reduction Methods for the Modeling and the Simulation of Vombustion Processes	4 CR	Bykov, Maas
T-MACH-105400	Scaling in Fluid Dynamics	4 CR	Bühler
T-MACH-105422	Flows with Chemical Reactions	4 CR	Class
T-MACH-105403	Flows and Heat Transfer in Energy Technology	4 CR	Cheng
T-MACH-105559	Technical Energy Systems for Buildings 1: Processes & Components	4 CR	Schmidt
T-MACH-105560	Technical Energy Systems for Buildings 2: System Concept	4 CR	Schmidt
T-MACH-105225	Thermal Solar Energy	4 CR	Stieglitz
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-106372	Thermal-Fluid-Dynamics	4 CR	Ruck
T-MACH-105365	Turbine and Compressor Design	4 CR	Bauer
T-MACH-108784	Vacuum and Tritium Technology in Nuclear Fusion	4 CR	Bornschein, Day
T-MACH-105292	Heat and Mass Transfer	4 CR	Bockhorn, Maas
T-MACH-105430	Heatpumps	4 CR	Maas, Wirbser
T-MACH-105416	Hydrogen Technologies	4 CR	Jordan
T-MACH-105234	Windpower	4 CR	Lewald
T-MACH-105406	Two-Phase Flow and Heat Transfer	4 CR	Schulenberg, Wörner

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Energy and Environmental Engineering serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.9 Module: Major Field Fundamentals of Engineering [M-MACH-104847]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
60	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Ingenieurwissenschafliche Grundlagen ()			
T-MACH-105293	Mathematical Methods in Dynamics	6 CR	Proppe
T-MACH-100297	Mathematical Methods in Strength of Materials	5 CR	Böhlke
T-MACH-105294	Mathematical Methods of Vibration Theory	6 CR	Seemann
T-MACH-105295	Mathematical Methods in Fluid Mechanics	6 CR	Frohnapfel
T-MACH-105298	Mathematical Methods in Structural Mechanics	5 CR	Böhlke
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-109192	Methods and Processes of PGE - Product Generation Development	6 CR	Albers, Burkardt, Matthiesen
T-MACH-105297	Modeling and Simulation	7 CR	Furmans, Geimer, Pritz, Proppe
T-MACH-105383	Product Development - Dimensioning of Components	7 CR	Dietrich, Schulze
T-MACH-105204	Excercises in Technical Thermodynamics and Heat Transfer I	0 CR	Maas
T-MACH-104747	Technical Thermodynamics and Heat Transfer I	8 CR	Maas
T-MACH-105288	Excercises in Technical Thermodynamics and Heat Transfer II	0 CR	Maas
T-MACH-105287	Technical Thermodynamics and Heat Transfer II	7 CR	Maas
T-MACH-106830	Tutorial Mathematical Methods in Strength of Materials	1 CR	Böhlke
T-MACH-106831	Tutorial Mathematical Methods in Structural Mechanics	1 CR	Böhlke

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
In the Major Field Fundamentals of Engineering, students acquire sound basic knowledge in engineering. With this in-depth knowledge of scientific theories, principles and methods, students can successfully deal with clearly specified problems that have a unique solution approach in mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.10 Module: Major Field Materials and Structures for High Performance Systems [M-MACH-104854]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	1

Election notes

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Werkstoffe und Strukturen für Hochleistungssysteme ()			
T-MACH-105527	Applied Materials Modelling	4 CR	Gumbsch, Schulz
T-MACH-100288	Working Methods in Materials Science and Technology	2 CR	Heilmaier
T-MACH-105150	Constitution and Properties of Protective Coatings	4 CR	Ulrich
T-MACH-105310	Design of Highly Stresses Components	4 CR	Aktaa
T-MACH-105651	Biomechanics: design in nature and inspired by nature	4 CR	Mattheck
T-MACH-108721	Designing with Composites	4 CR	Schnack
T-MACH-105320	Introduction to the Finite Element Method	4 CR	Böhlke, Langhoff
T-MACH-105321	Introduction to Theory of Materials	4 CR	Kamlah
T-MACH-105984	Fatigue of Welded Components and Structures	3 CR	Farajian, Gumbsch
T-MACH-105447	Metallographic Lab Class	4 CR	Hauf
T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups	4 CR	Dietrich
T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-105392	FEM Workshop - Constitutive Laws	4 CR	Schulz, Weygand
T-MACH-107667	Solid State Reactions and Kinetics of Phase	4 CR	Franke, Seifert
T-MACH-105417	Finite Element Workshop	4 CR	Mattheck, Weygand
T-MACH-105179	Functional Ceramics	4 CR	Hinterstein, Rheinheimer
T-MACH-105157	Foundry Technology	4 CR	Wilhelm
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-105398	High Performance Computing	5 CR	Nestler, Selzer
T-MACH-100287	Introduction to Ceramics	6 CR	Hoffmann
T-MACH-106722	Ceramic Matrix Composites	4 CR	Koch
T-MACH-100293	Structural Materials	6 CR	Guth, Lang
T-MACH-105164	Laser in Automotive Engineering	4 CR	Schneider
T-MACH-100285	Materials Physics and Metals	13 CR	Heilmaier, Pundt
T-MACH-100290	Seminar in Materials Science	2 CR	Gruber, Wagner
T-MACH-105333	Mechanics and Strength of Polymers	4 CR	von Bernstorff
T-MACH-105468	Metals	6 CR	Heilmaier, Pundt
T-MACH-105303	Modelling of Microstructures	5 CR	August, Nestler
T-MACH-100300	Modelling and Simulation	5 CR	Gumbsch, Nestler
T-MACH-102102	Physical Basics of Laser Technology	5 CR	Schneider
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-102137	Polymer Engineering I	4 CR	Elsner

T-MACH-102138	Polymer Engineering II	4 CR	Elsner
T-MACH-102154	Laboratory Laser Materials Processing	4 CR	Schneider
T-MACH-105178	Practical Course Technical Ceramics	1 CR	Schell
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-105170	Welding Technology	4 CR	Farajian
T-MACH-105354	Fatigue of Metallic Materials	4 CR	Guth, Lang
T-MACH-102179	Structural Ceramics	4 CR	Hoffmann
T-MACH-102103	Superhard Thin Film Materials	4 CR	Ulrich
T-MACH-100531	Systematic Materials Selection	4 CR	Dietrich
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-105531	Tribology	8 CR	Dienwiebel, Scherge
T-MACH-109304	Excercises - Fatigue of Welded Components and Structures	1 CR	Farajian, Gumbsch
T-MACH-109303	Exercices - Tribology	0 CR	Dienwiebel
T-MACH-107671	Exercises for Applied Materials Simulation	2 CR	Gumbsch, Schulz
T-MACH-107632	Exercises for Solid State Reactions and Kinetics of Phase Transformations	2 CR	Franke, Seifert
T-MACH-107685	Exercises for Materials Characterization	2 CR	Gibmeier
T-MACH-102139	Failure of Structural Materials: Fatigue and Creep	4 CR	Gruber, Gumbsch
T-MACH-102140	Failure of Structural Materials: Deformation and Fracture	4 CR	Gumbsch, Weygand
T-MACH-107684	Materials Characterization	4 CR	Gibmeier
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-105301	Materials Science and Engineering III	8 CR	Heilmaier
T-MACH-105369	Materials Modelling: Dislocation Based Plasticy	4 CR	Weygand
T-MACH-100295	Materials Processing Technology	6 CR	Binder, Weidenmann

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Materials and Structures for High Performance Systems serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

2.11 Module: Major Field Mechatronics and Microsystem Technology [M-MACH-104850]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Mechatronik und Mikrosystemtechnik ()			
T-MACH-105238	Actuators and Sensors in Nanotechnology	4 CR	Kohl
T-MACH-105217	Automation Systems	4 CR	Kaufmann
T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	4 CR	Guber
T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	4 CR	Guber
T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	4 CR	Guber
T-MACH-102172	Bionics for Engineers and Natural Scientists	4 CR	Hölscher
T-MACH-102169	Chemical, Physical and Material Scientific Aspects of Polymers in Microsystem Technologies	3 CR	Worgull
T-MACH-105314	Computational Intelligence	4 CR	Jakob, Mikut, Reischl
T-MACH-105694	Data Analytics for Engineers	5 CR	Ludwig, Mikut, Reischl
T-MACH-105317	Digital Control	4 CR	Knoop
T-MACH-100535	Introduction into Mechatronics	6 CR	Böhland, Lorch, Reischl
T-MACH-105228	Organ Support Systems	4 CR	Pylatiuk
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-MACH-105328	Information Processing in Mechatronic Systems	4 CR	Kaufmann
T-MACH-105378	Cognitive Automobiles - Laboratory	6 CR	Kitt, Lauer, Stiller
T-MACH-105334	Mechanics in Microtechnology	4 CR	Greiner, Gruber
T-MACH-105370	Laboratory Mechatronics	4 CR	Lorch, Seemann, Stiller
T-MACH-105335	Measurement II	4 CR	Stiller
T-MACH-105300	Measurement Instrumentation Lab	4 CR	Spindler, Stiller
T-MACH-101910	Microactuators	4 CR	Kohl
T-MACH-105539	Modern Control Concepts I	4 CR	Groell, Matthes
T-MACH-105180	Nanotechnology for Engineers and Natural Scientists	4 CR	Dienwiebel, Hölscher, Walheim
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications	4 CR	Rapp
T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications	4 CR	Worgull
T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics	4 CR	Rapp, Worgull
T-MACH-105341	Lab Computer-Aided Methods for Measurement and Control	4 CR	Stiller
T-MACH-102164	Practical Training in Basics of Microsystem Technology	4 CR	Last
T-MACH-105555	System Integration in Micro- and Nanotechnology	4 CR	Gengenbach

T-MACH-105360	Computer Engineering	6 CR	Keller, Lorch
T-MACH-102149	Virtual Reality Practical Course	4 CR	Ovtcharova

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Mechatronics and Microsystem Technology serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.12 Module: Major Field Product Development and Construction [M-MACH-104851]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	1

Election notes

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Produktentwicklung und Konstruktion ()			
T-MACH-106744	Agile Product Innovation Management - Value-driven Planning of new Products	4 CR	Kläger
T-MACH-105215	Applied Tribology in Industrial Product Development	4 CR	Albers, Lorentz, Matthiesen
T-MACH-102185	CATIA CAD Training Course	2 CR	Ovtcharova
T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery	4 CR	Albers, Matthiesen, Ott
T-MACH-102187	CAD-NX Training Course	2 CR	Ovtcharova
T-MACH-105212	CAE-Workshop	4 CR	Albers, Matthiesen
T-MACH-105312	CATIA Advanced	4 CR	Ovtcharova
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-106743	IoT Platform for Engineering	4 CR	Ovtcharova
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105221	Lightweight Engineering Design	4 CR	Albers, Burkardt
T-MACH-105231	Leadership and Management Development	4 CR	Albers, Matthiesen, Ploch
T-MACH-105442	Intellectual Property Rights and Strategies in Industrial Companies	4 CR	Albers, Matthiesen, Zacharias
T-MACH-105440	Leadership and Conflict Management	4 CR	Hatzl
T-MACH-105347	Project Management in Global Product Engineering Structures	4 CR	Albers, Gutzmer, Matthiesen
T-MACH-105696	Strategic product development - identification of potentials of innovative products	3 CR	Albers, Matthiesen, Siebe
T-MACH-105358	Sustainable Product Engineering	4 CR	Albers, Matthiesen, Ziegahn
T-MACH-105361	Technical Design in Product Development	4 CR	Albers, Matthiesen, Schmid
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova
T-MACH-102124	Virtual Engineering II	4 CR	Ovtcharova

Competence Certificate

Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal

Major Field Product Development and Construction serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites

Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content

See individual bricks

2.13 Module: Major Field Production Technology [M-MACH-104852]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	2

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Produktionstechnik ()			
T-MACH-102092	Industrial Application of Material Handling Systems in Sorting and Distribution Systems	4 CR	Föller
T-MACH-105518	Human Factors Engineering I	4 CR	Deml
T-MACH-105519	Human Factors Engineering II	4 CR	Deml
T-MACH-105830	Human Factors Engineering III: Empirical research methods	4 CR	Deml
T-MACH-108844	Automated Manufacturing Systems	8 CR	Fleischer
T-MACH-102105	Manufacturing Technology	8 CR	Schulze, Zanger
T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics	4 CR	Furmans
T-MACH-102163	Basics of Technical Logistics	6 CR	Mittwollen, Oellerich
T-MACH-105388	Introduction to Industrial Production Economics	4 CR	Dürrschnabel
T-MACH-105386	Occupational Safety and Environmental Protection	4 CR	von Kiparski
T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0	8 CR	Lanza
T-MACH-102128	Information Systems and Supply Chain Management	3 CR	Kilger
T-MACH-105174	Warehousing and Distribution Systems	3 CR	Furmans
T-MACH-102089	Logistics - Organisation, Design and Control of Logistic Systems	6 CR	Furmans
T-MACH-102151	Material Flow in Logistic Systems	9 CR	Furmans
T-MACH-105470	Production Planning and Control	4 CR	Rinn
T-MACH-105346	Production Techniques Laboratory	4 CR	Deml, Fleischer, Furmans, Ovtcharova
T-MACH-105523	Productivity Management in Production Systems	4 CR	Stowasser
T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems	5 CR	Schulze
T-MACH-102107	Quality Management	4 CR	Lanza
T-MACH-105171	Safety Engineering	4 CR	Kany
T-MACH-105185	Control Technology	4 CR	Gönnheimer
T-MACH-105181	Supply Chain Management	6 CR	Alicke
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105177	Metal Forming	4 CR	Herlan
T-MACH-102148	Gear Cutting Technology	4 CR	Klaiber
T-MACH-109055	Machine Tools and Industrial Handling	8 CR	Fleischer

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Production Technology serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.14 Module: Major Field Theoretical Foundations of Mechanical Engineering [M-MACH-104853]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
90	German/English	4	2

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Theoretischer Maschinenbau ()			
T-MACH-105209	Introduction into the Multi-Body Dynamics	5 CR	Seemann
T-MACH-108718	Introduction to numerical mechanics	4 CR	Schnack
T-MACH-108808	Introduction to Engineering Mechanics I: Statics	3 CR	Fidlin
T-MACH-102208	Introduction to Engineering Mechanics I: Statics and Strength of Materials	5 CR	Fidlin
T-MACH-105439	Introduction to Nonlinear Vibrations	7 CR	Fidlin
T-MACH-105514	Experimental Dynamics	5 CR	Fidlin
T-MACH-105474	Fluid-Structure-Interaction	4 CR	Frohnapfel, Mühlhausen
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	4 CR	Kamlah
T-MACH-105396	Modeling of Thermodynamical Processes	6 CR	Maas, Schießl
T-MACH-108720	Numerical Mechanics for Industrial Applications	4 CR	Schnack
T-MACH-105420	Numerical Simulation of Multi-Phase Flows	4 CR	Wörner
T-MACH-105348	Process Simulation in Forming Operations	4 CR	Helm
T-MACH-105349	Computational Dynamics	4 CR	Proppe
T-MACH-105384	Computerized Multibody Dynamics	4 CR	Seemann
T-MACH-105351	Computational Mechanics I	6 CR	Böhlke, Langhoff
T-MACH-105352	Computational Mechanics II	6 CR	Böhlke, Langhoff
T-MACH-105373	Practical Training in Measurement of Vibrations	4 CR	Fidlin
T-MACH-105372	Theory of Stability	6 CR	Fidlin
T-MACH-105458	Flow Simulations	4 CR	Frohnapfel
T-MACH-105290	Vibration Theory	5 CR	Fidlin, Seemann
T-MACH-105443	Wave Propagation	4 CR	Seemann

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Major Field Theoretical Foundations of Mechanical Engineering serves as a comprehensive, in-depth analysis in selected areas of mechanical engineering.

Prerequisites
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Content
See individual bricks

M 2.15 Module: Specification in Mechanical Engineering [M-MACH-104878]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: KIT-Department of Mechanical Engineering Courses

Credits	Language	Level	Version
60	German/English	4	1

Election notes
Exchange students are allowed to choose bricks from this module. There may be prerequisites or restrictions, for instance regarding the number of places for individual courses. Exchange students do not need to choose the whole module, but can select individual bricks.

Election block: Exchange Students_Englischsprachige Teilleistungen_Wahl ()			
T-MACH-108689	Advanced Materials Thermodynamics: Experiments and Modelling	4 CR	Seifert
T-MACH-105308	Atomistic Simulations and Molecular Dynamics	4 CR	Brandl, Gumbsch, Schneider
T-MACH-105381	Virtual Engineering (Specific Topics)	4 CR	Ovtcharova
T-MACH-105407	CFD in Power Engineering	4 CR	Otic
T-MACH-106698	A holistic approach to power plant management	4 CR	Seidl, Stieglitz
T-ETIT-100807	Electrical Machines	4 CR	Becker
T-MACH-105154	Vehicle Comfort and Acoustics I	4 CR	Gauterin
T-MACH-105155	Vehicle Comfort and Acoustics II	4 CR	Gauterin
T-MACH-105444	Combined Cycle Power Plants	4 CR	Schulenberg
T-MACH-105220	Fundamentals of Energy Technology	8 CR	Badea, Cheng
T-MACH-100092	Automotive Engineering I	8 CR	Gauterin, Unrau
T-MACH-102117	Automotive Engineering II	4 CR	Gauterin, Unrau
T-MACH-105379	Global Logistics	4 CR	Furmans
T-MACH-105182	Introduction to Microsystem Technology I	4 CR	Badilita, Jouda, Korvink
T-MACH-105183	Introduction to Microsystem Technology II	4 CR	Jouda, Korvink
T-MACH-105162	Fundamentals of Automobile Development I	2 CR	Frech
T-MACH-105163	Fundamentals of Automobile Development II	2 CR	Frech
T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation	4 CR	Dagan
T-MACH-105402	Nuclear Power Plant Technology	4 CR	Badea, Cheng, Schulenberg
T-MACH-105410	Coal Fired Power Plants	4 CR	Schulenberg
T-MACH-105223	Machine Vision	8 CR	Lauer, Stiller
T-MACH-105434	Magnet Technology of Fusion Reactors	4 CR	Fietz, Weiss
T-MACH-105210	Machine Dynamics	5 CR	Proppe
T-MACH-105224	Machine Dynamics II	4 CR	Proppe
T-MACH-105189	Mathematical Models and Methods for Production Systems	6 CR	Baumann, Furmans
T-MACH-105557	Microenergy Technologies	4 CR	Kohl
T-MACH-105782	Micro Magnetic Resonannce	4 CR	Korvink, MacKinnon
T-MACH-105532	Nonlinear Continuum Mechanics	5 CR	Böhlke
T-WIWI-100806	Renewable Energy-Resources, Technologies and Economics	4 CR	Jochem, McKenna
T-MACH-105445	Simulator Exercises Combined Cycle Power Plants	2 CR	Schulenberg
T-MACH-105456	Ten Lectures on Turbulence	4 CR	Otic

T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-105554	Thin Film and Small-scale Mechanical Behavior	4 CR	Gruber, Schwaiger, Weygand
T-MACH-102123	Virtual Engineering I	4 CR	Ovtcharova
T-MACH-102124	Virtual Engineering II	4 CR	Ovtcharova
T-MACH-105529	Heat Transfer in Nuclear Reactors	4 CR	Cheng
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier

Competence Certificate
Oral exams: duration approx. 5 min per credit point

Written exams: duration approx. 20 - 25 min per credit point

Amount, type and scope of the success control can vary according to the individually choice.

Competence Goal
Incoming Students_Bricks in English serves as a comprehensive, of fundamentals in selected areas of mechanical engineering.

Prerequisites
None

Content
See individual bricks

Annotation
The courses in this module are offered in English.

3 Courses

T 3.1 Course: A holistic approach to power plant management [T-MACH-106698]

Responsible: Dr. Marcus Seidl
Prof. Dr. Robert Stieglitz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2189404	A holistic approach to power plant management	2 SWS	Lecture (V)	Seidl, Stieglitz
WS 19/20	2189404	A holistic approach to power plant management	2 SWS	Lecture (V)	Seidl
Exams					
WS 19/20	76-T-MACH-106698	A holistic approach to power plant management		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

Below you will find excerpts from events related to this course:

V A holistic approach to power plant management — Lecture (V)

2189404, WS 19/20, 2 SWS, Language: English, Open in study portal

Description
Main Contents:

The structure ofelectricity markets

Requirements from network operators

The basics of commodity markets

The impact of regulation on power plant operation

The role of behavioral economics in power plant decision making

Integration of renewable energy sources into the electricity market

Calibration of power plant operation and maintenance to market requirements

Asset management for power plant fleets

Applying financial engineering to optimize asset utilization

Day-to-day decision making for power plant operation

Notes

Main Contents:

The structure ofelectricity markets

Requirements from network operators

The basics of commodity markets

The impact of regulation on power plant operation

The role of behavioral economics in power plant decision making

Integration of renewable energy sources into the electricity market

Calibration of power plant operation and maintenance to market requirements

Asset management for power plant fleets

Applying financial engineering to optimize asset utilization

Day-to-day decision making for power plant operation

The lecture provides an overview of the many practical aspects of power plant operation. For this purpose, the knowledge of the energy and commodity markets, the regulatory boundary conditions, the energy trading instruments, the principles of fleet management and the requirements of power plant maintenance are required.

For the purpose of an efficient management of a power plant fleet it is explained how a variety of statistical models can be used to determine the optimal combination of resource purchases, outage management, load availability and ask prices.

Each credit point equals to 25-30 h working time of a student. Thereby, the time is based on an average student finishing with and average score. The working time can be split into: 1 attendance of the lectures, 2. pre- and post-processing of the lecture, 3 preparations for examination.

Students understand the many aspects of power plant operation: the structure of the energy and commodity markets, the regulatory boundary conditions, the energy trading instruments, the principles of fleet management and the requirements of power plant maintenance.

Furthermore, students can develop on their own a suitable strategy for the management of a power plant fleet.

Oral exam of about 25 min.

Learning Content

The lecture provides an overview of the many practical aspects of power plant operation. For this purpose, the knowledge of the energy and commodity markets, the regulatory boundary conditions, the energy trading instruments, the principles of fleet management and the requirements of power plant maintenance are required.

For the purpose of an efficient management of a power plant fleet it is explained how a variety of statistical models can be used to determine the optimal combination of resource purchases, outage management, load availability and ask prices.

Workload

Each credit point equals to 25-30 h working time of a student. Thereby, the time is based on an average student finishing with and average score. The working time can be split into: 1 attendance of the lectures, 2. pre- and post-processing of the lecture, 3 preparations for examination.

Literature

G. Balzer, C. Schorn, Asset Management für Infrastrukturanlagen - Energie und Wasser, VDI

R. Weron, Modeling and Forecasting Electricity Loads and Prices: A Statistical Approach, Wiley

D. Edwards, Energy Trading and Investing: Trading, Risk Management and Structuring Deals in the Energy Market, McGraw-Hill

T 3.2 Course: Actuators and Sensors in Nanotechnology [T-MACH-105238]

Responsible: Prof. Dr. Manfred Kohl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141866	Actuators and sensors in nanotechnology	2 SWS	Lecture (V)	Kohl, Sommer

Competence Certificate
oral exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Actuators and sensors in nanotechnology — Lecture (V)
2141866, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
- Physical principles of actuation and sensing
- Scaling and size effects
- Fabrication technologies
- Selected developments
- Applications

The lecture includes amongst others the following topics:
Nano technologies
Nano electro mechanical systems (NEMS)
Nano magneto mechanical and multiferroic systems
Polymer-based nano actuators
Nano motors, molecular systems
Adaptive nano optical systems
Nanosensors: concepts, materials, fabrication
Examples on different categories of materials and applications:
C-based, MeOx-based nano sensors
Physical, chemical, biological nano sensors
Multivariant data analysis / interpretation

Workload
time of attendance: 1.5 hours/week
Self-study: 8.5 hours/week

Literature

- Lecture notes

- 2. Balzani, V., Credi, A., & Venturi, M., Molecular devices and machines: concepts and perspectives for the nanoworld, 2008

- "Nanowires and Nanobelts, - Materials, Properties and Devices -, Volume 2: Nanowires and Nanobelts of Functional Materials", Edited by Zhong Lin Wang, Springer, 2003, ISBN 10 0-387-28706-X

- "Sensors Based on Nanostructured Materials", Edited by Francisco J. Arregui, Springer, 2009, ISBN: 978-0-387-77752-8

- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

T 3.3 Course: Advanced Materials Thermodynamics: Experiments and Modelling [T-MACH-108689]

Responsible: Prof. Dr. Hans Jürgen Seifert
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2194660	Advanced Materials Thermodynamics: Experiments and Modelling	2 SWS	Lecture (V)	Seifert, Franke
Exams					
SS 2019	76-T-MACH-108689	Advanced Materials Thermodynamics: Experiments and Modelling		Prüfung (PR)	Seifert

Competence Certificate
oral exam (about 30 min)

Prerequisites
none

Recommendation
Basics in thermodynamics (lectures during bachelor degree course in engineering, materials science and engineering (MatWerk), physics or chemistry)

Below you will find excerpts from events related to this course:

V Advanced Materials Thermodynamics: Experiments and Modelling — Lecture (V)
2194660, SS 2019, 2 SWS, Language: German/English, Open in study portal

Notes

- Fundamentals of thermodynamics
- Introduction to experimental methods for the determination of phase diagrams and the measurement of thermodynamic properties
- Thermal analysis and differential scanning calorimetry to determine phase transformation temperatures, enthalpies of transformation, and heat capacities
- The drop calorimetry and solution calorimetry methods to be able to measure enthalpies of formation of intermetallic and oxide compounds.
- EMF and KEMS methods for the measurement of chemical potentials
- Introduction to computational thermodynamics and the Calphad method
- Thermodynamic modelling
- Calculation of binary and ternary phase diagrams using Thermo-Calc software
- Calculation of property diagrams using Thermo-Calc software

This course focuses on the experimental methods which are used to investigate binary and ternary phase diagrams as well as those methods which can be employed to measure thermodynamic properties of multi-component systems. Additionally, participants will be able to understand thermodynamic models used to describe the Gibbs free energies of stoichiometric and solution phases, as well as to use Thermo-Calc software to calculate binary and ternary phase diagrams and property diagrams.

- Attendance in Lecture: 18 Stunden
- Extra Requirements: 98 Stunden

Recommendations:

- Fundamentals of Thermodynamics / Heterogeneous Equilibria (with exercises)
- Solid State Reactions and Kinetics of Phase Transformations and Corrosion (with Exercises)

Oral examination (ca. 30 Min)

Learning Content

- Fundamentals of thermodynamics
- Introduction to experimental methods for the determination of phase diagrams and the measurement of thermodynamic properties
- Thermal analysis and differential scanning calorimetry to determine phase transformation temperatures, enthalpies of transformation, and heat capacities
- The drop calorimetry and solution calorimetry methods to be able to measure enthalpies of formation of intermetallic and oxide compounds.
- EMF and KEMS methods for the measurement of chemical potentials
- Introduction to computational thermodynamics and the Calphad method
- Thermodynamic modelling
- Calculation of binary and ternary phase diagrams using Thermo-Calc software
- Calculation of property diagrams using Thermo-Calc software

Workload

- Attendance in Lecture: 18 Stunden
- Extra Requirements: 98 Stunden

Literature

- Hemminger, W.F., Cammenga, H.K. : Methoden der Thermischen Analyse, Springer Verlag, Berlin Heidelberg, 1989
- Höhne, G.W.H., Hemminger, W.F., Flammersheim, H.-J.: Differential Scanning Calorimetry, Springer Verlag, Berlin Heidelberg, 2003
- Sarge, S.F., Höhne, W.H., Hemminger, W.: Calorimetry: Fundamentals, Instrumentation and Applications, Wiley-VCH Verlag, Weinham, 2014
- Lukas, H.L., Fries, S.G., Sundman, B. : Computational Thermodynamics: The Calphad Method, Cambridge University Press, New York, 2007

T 3.4 Course: Aerodynamics [T-MACH-105528]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Frank Ohle

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154420	Aerodynamics	2 SWS		Ohle
Exams					
SS 2019	76-T-MACH-105528	Aerodynamics		Prüfung (PR)	Frohnapfel

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Aerodynamics
2154420, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

- Basics of aerodynamics
- Basic properties of flowing gas
- Potential Theory
- Airfoils (2-D wing)
- The finite (3-D) wing
- Airplane performance
- CFD
- Experimental verification

Annotation
Block course with limited number of participants, registration in the secretary's office required.

See details at www.istm.kit.edu.

Workload
regular atendance: 20h

self studie: 100h

Literature
J.D. Anderson, jr.. Fundamentals of Aerodynamics, McGraw-Hill

E.L. Houghton. Aerodynamics for Engineering Students, Butterworth-Heinemann (Elsevier)

Schlichting, Gersten. Grenzschichttheorie, Springer

T 3.5 Course: Agile Product Innovation Management - Value-driven Planning of new Products [T-MACH-106744]

Responsible: Dr.-Ing. Roland Kläger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	3

Events					
SS 2019	2122300	Agile product innovation management - value-driven planning of new products	SWS	Lecture (V)	Kläger
Exams					
SS 2019	76-T-MACH-106744	Agile Product Innovation Management - Value-driven Planning of new Products		Prüfung (PR)	Kläger

Competence Certificate
Oral examination, 20 min.

Prerequisites
None

T 3.6 Course: Alternative Powertrain for Automobiles [T-MACH-105655]

Responsible: Prof.Dipl.-Ing. Karl Ernst Noreikat
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2133132	Alternative Powertrains for Automobiles	2 SWS	Lecture (V)	Noreikat
Exams					
SS 2019	76-T-MACH-105655	Alternative Powertrain for Automobiles		Prüfung (PR)	Noreikat
WS 19/20	76-T-MACH-105655	Alternative Powertrain for Automobiles		Prüfung (PR)	Noreikat

Competence Certificate
written exam

Below you will find excerpts from events related to this course:

V Alternative Powertrains for Automobiles
2133132, WS 19/20, 2 SWS, Open in study portal **Lecture (V)**

Notes
History

Infrastructure

Market Situation

Legislation

Alternative Fuels

Innovative Drivetrains

Hybrids

Plug-In Hybrids

BEV

Fuel Cells

T 3.7 Course: Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines [T-MACH-105173]

Responsible: Dr.-Ing. Marcus Gohl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134150	Analysis of Exhaust Gas und Lubricating Oil in Combustion Engines	2 SWS	Lecture (V)	Gohl
Exams					
SS 2019	76--T-Mach-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines		Prüfung (PR)	Gohl
WS 19/20	76-T-MACH-105173	Analysis of Exhaust Gas and Lubricating Oil in Combustion Engines		Prüfung (PR)	Koch

Competence Certificate
Letter of attendance or oral exam (25 minutes, no auxillary means)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Analysis of Exhaust Gas und Lubricating Oil in Combustion Engines

2134150, SS 2019, 2 SWS, Language: German, Open in study portal **Lecture (V)**

Description
Media:

Lecture with Powerpoint slides

Learning Content
The students get involved in the application of different measurement techniques in the field of exhaust gas and lubricating oil analysis. The functional principles of the systems as well as the application areas of the latter are discussed. In addition to a general overview of standard applications, current specific development and research activities are introduced.

Workload
regular attendance: 24 hrs

self study: 96 hrs

Literature
The lecture documents are distributed during the courses.

T 3.8 Course: Analysis Tools for Combustion Diagnostics [T-MACH-105167]

Responsible: Jürgen Pfeil
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134134	Analysis tools for combustion diagnostics	2 SWS	Lecture (V)	Pfeil
Exams					
WS 19/20	76-T-MACH-105167	Analysis Tools for Combustion Diagnostics		Prüfung (PR)	Koch

Competence Certificate
oral examination, Duration: 25 min., no auxiliary means

Prerequisites
none

Below you will find excerpts from events related to this course:

V Analysis tools for combustion diagnostics
2134134, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
energy balance at the engine

energy conversion in the combustion chamber

thermodynamics of the combustion process

flow velocities

flame propagation

special measurement techniques

Workload
regular attendance: 24 hours
self-study: 96 hours

Literature
Lecture notes available in the lectures

T 3.9 Course: Applied Materials Modelling [T-MACH-105527]

Responsible: Prof. Dr. Peter Gumbsch
Dr. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2182614	Applied Materials Modelling	4 SWS	Lecture / Practice (VÜ)	Schulz, Gumbsch
Exams					
SS 2019	76-T-MACH-105527	Applied Materials Modelling		Prüfung (PR)	Gumbsch, Schulz

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

Prerequisites
The successful participation in Exercises for Applied Materials Modelling is the condition for the admittance to the oral exam in Applied Materials Modelling.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107671 - Exercises for Applied Materials Simulation must have been passed.

Below you will find excerpts from events related to this course:

V Applied Materials Modelling
2182614, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

black board, beamer, script, computer exercise

Notes
This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods and distinguish between different models

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content
This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

Workload
regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

Literature

1. D. Frenkel, B. Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2001
2. W. Kurz, D.J. Fisher: Fundamentals of Solidification, Trans Tech Publications, 1998
3. P. Haupt: Continuum Mechanics and Theory of Materials, Springer, 1999
4. M. P. Allen, D. J. Tildesley: Computer simulation of liquids, Clarendon Press, 1996

T 3.10 Course: Applied Tribology in Industrial Product Development [T-MACH-105215]

Responsible: Prof. Dr.-Ing. Albert Albers
Dr.-Ing. Benoit Lorentz
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2145181	Applied Tribology in Industrial Product Development	2 SWS	Lecture (V)	Lorentz

Competence Certificate
oral exam (20 min)

Prerequisites
None

Below you will find excerpts from events related to this course:

V Applied Tribology in Industrial Product Development

Lecture (V)

2145181, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The aim of the lecture is to discuss tribological problems, tribological features and the tribological variety on examples of the industry.

The students are able to

- define a tribological system,
- design a tribological system,
- discuss wear and damage impacts,
- explain measurement techniques to investigate tribological systems and
- show the limits of a tribological system.

Further content:

- Friction, Wear, Wear Measurement
- Lubricant (Oil, Grease, etc.)
- Hydrodynamic and elastohydrodynamic Lubrication
- Design of Tribologic Working Surface Pairs
- Technique of Measurement in Lubricated Contacts
- Prevention of Maschine Failure
- Protective Surface Layers
- Journal Bearings, Roller Bearings
- Gear Wheels and Transmissions

Learning Content
Friction, Wear, Wear Measurement

Lubricant (Oil, Grease, etc.)

Hydrodynamic and elastohydrodynamic Lubrication

Design of Tribologic Working Surface Pairs

Technique of Measurement in Lubricated Contacts

Prevention of Maschine Failure

Protective Surface Layers

Journal Bearings, Roller Bearings

Gear Wheels and Transmissions

Workload
regular attendance: 21 h

self-study: 99 h

Literature
The lecture script will be allocated at Ilias.

T 3.11 Course: Atomistic Simulations and Molecular Dynamics [T-MACH-105308]

Responsible: Dr. Christian Brandl
Prof. Dr. Peter Gumbsch
Dr.-Ing. Johannes Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2181740	Atomistic simulations and molecular dynamics	2 SWS	Lecture (V)	Gumbsch
SS 2019	2181741	Lab for 'Atomistic simulations and molecular dynamics'	2 SWS	Practice (Ü)	Gumbsch

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Below you will find excerpts from events related to this course:

V Atomistic simulations and molecular dynamics

Lecture (V)

2181740, SS 2019, 2 SWS, Language: English, Open in study portal

Notes
The lecture introduces the foundation of particle based simulation methods focussing on molecular dynamics:

1. Introduction
2. Physics of Materials
3. MD Basics, Atom-Billard
* particle, position, energy, forces, pair potentials
* initial and boundary conditions
* time integration
4. algorithms
5. statics, dynamics, thermodynamics
6. MD output
7. interaction between particles
* pair potential -- many body potentials
* principles of quantum mechanics
* tight binding methods
* dissipative particle dynamics
8. application of particle based methods

Exercises (2181741, 2 SWS) are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the physical foundation of particle based simulation method (e.g. molecular dynamics)
- apply particle based simulation methods to problems in materials science

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours
exercise: 22,5 hours
self-study: 75 hours

oral exam ca. 30 minutes

Learning Content
The lecture introduces the foundation of particle based simulation methods focussing on molecular dynamics:

1. Introduction
2. Physics of Materials
3. MD Basics, Atom-Billard
* particle, position, energy, forces, pair potentials
* initial and boundary conditions
* time integration
4. algorithms
5. statics, dynamics, thermodynamics
6. MD output
7. interaction between particles
* pair potential -- many body potentials
* principles of quantum mechanics
* tight binding methods
* dissipative particle dynamics
8. application of particle based methods

Exercises (2181741, 2 SWS) are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

Workload
regular attendance: 22,5 hours
exercise: 22,5 hours
self-study: 75 hours

Literature

1. Understanding Molecular Simulation: From Algorithms to Applications, Daan Frenkel and Berend Smit (Academic Press, 2001)
2. Computer simulation of liquids, M. P. Allen and Dominic J. Tildesley (Clarendon Press, Oxford, 1996)

V **Lab for 'Atomistic simulations and molecular dynamics'** **Practice (Ü)**
2181741, SS 2019, 2 SWS, Language: English, Open in study portal

Notes
Introduction to the basic usage of the MD software package IMD:

* generating initial structures
* energy calculations
* defects in lattices
* visualization of MD structures

The students will be able to use a standard molecular dyanamics software package.

Learning Content
Introduction to the basic usage of the MD software package IMD:

* generating initial structures
* energy calculations
* defects in lattices
* visualization of MD structures

Workload
see lecture

Literature
see lecture

T 3.12 Course: Automated Manufacturing Systems [T-MACH-108844]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2150904	Automated Manufacturing Systems	6 SWS	Lecture / Practice (VÜ)	Fleischer
Exams					
SS 2019	76-T-MACH-108844	Automated Manufacturing Systems		Prüfung (PR)	Fleischer

Competence Certificate
oral exam (40 minutes)

Prerequisites
"T-MACH-102162 - Automatisierte Produktionsanlagen" must not be commenced.

Below you will find excerpts from events related to this course:

V Automated Manufacturing Systems

2150904, SS 2019, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

The lecture provides an overview of the structure and functioning of automated manufacturing systems. In the introduction chapter the basic elements for the realization of automated manufacturing systems are given. This includes:

- Drive and control technology
- Handling technology for handling work pieces and tools
- Industrial Robotics
- Quality assurance in automated manufacturing
- automatic machines, cells, centers and systems for manufacturing and assembly
- structures of multi-machine systems
- planning of automated manufacturing systems

An interdisciplinary view of these subareas enables Industry 4.0 solutions.
In the second part of the lecture, the basics are illustrated using implemented manufacturing processes for the production of automotive components (chassis and drive technology).The analysis of automated manufacturing systems for manufacturing of
defined components is also included.
In the field of vehicle power train both, the automated manufacturing process for the production of the conventional internal-combustion engine and the automated manufacturing process for the production of the prospective electric power train
(electric motor and battery) are considered. In the field of car body, the focus is on the analysis of the process chain for the automated manufacturing of conventional sheet metal body parts, as well as for automated manufacturing of body components made out of
fiber-reinforced plastics.
Within tutorials, the contents from the lecture are advanced and applied to specific problems and tasks.

Learning Outcomes:

The students ...

- are able to analyze implemented automated manufacturing systems and describe their components.
- are capable to assess the implemented examples of implemented automated manufacturing systems and apply them to new problems.
- are able to name automation tasks in manufacturing plants and name the components which are necessary for the implementation of each automation task.
- are capable with respect to a given task to plan the configuration of an automated manufacturing system and to determine the necessary components to its realization.
- are able to design and select components for a given use case of the categories: "Handling Technology", "Industrial Robotics", "Sensory" and "Controls".
- are capable to compare different concepts for multi-machine systems and select a suitable concept for a given use case.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours
WING:
regular attendance: 63 hours
self-study: 207 hours

Learning Content
The lecture provides an overview of the structure and functioning of automated manufacturing systems. In the introduction chapter the basic elements for the realization of automated manufacturing systems are given. This includes:

- Drive and control technology
- Handling technology for handling work pieces and tools
- Industrial Robotics
- Quality assurance in automated manufacturing
- automatic machines, cells, centers and systems for manufacturing and assembly
- structures of multi-machine systems
- planning of automated manufacturing systems

An interdisciplinary view of these subareas enables Industry 4.0 solutions.
In the second part of the lecture, the basics are illustrated using implemented manufacturing processes for the production of automotive components (chassis and drive technology).The analysis of automated manufacturing systems for manufacturing of
defined components is also included.
In the field of vehicle power train both, the automated manufacturing process for the production of the conventional internal-combustion engine and the automated manufacturing process for the production of the prospective electric power train
(electric motor and battery) are considered. In the field of car body, the focus is on the analysis of the process chain for the automated manufacturing of conventional sheet metal body parts, as well as for automated manufacturing of body components made out of
fiber-reinforced plastics.
Within tutorials, the contents from the lecture are advanced and applied to specific problems and tasks.

Annotation
None

Workload
MACH:
regular attendance: 63 hours
self-study: 177 hours
WING/TVWL:
regular attendance: 63 hours
self-study: 207 hours

Literature
Lecture Notes

T 3.13 Course: Automation Systems [T-MACH-105217]

Responsible: Prof. Dr.-Ing. Michael Kaufmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2106005	Automation Systems	2 SWS	Lecture (V)	Kaufmann

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Automation Systems

2106005, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- Introduction: Terms and definitions, examples, requirements
- Industrial processes: classification, process conditions
- Automation tasks
- Components of industrial automation systems: control functions, data acquisition, data output equipment, Programmable Logic Controllers, PC-based control
- Industrial communication, classification, topology, protocols, bus systems for automation systems
- Engineering: plant engineering, composition of control systems, programming
- Requirements on equipment, documentation, identification
- Dependability and safety
- Diagnosis
- Application examples

Workload
general attendance: 21 h

self-study: 99 h

Literature

- Gevatter, H.-J., Grünhaupt, U.: Handbuch der Mess- und Regelungstechnik in der Produktion. 2. Auflage, Berlin, Heidelberg: Springer-Verlag, 2006.
- Langmann, R.: Taschenbuch der Automatisierung. München: Fachbuchverlag Leipzig, 2010.
- Strohrmann, G.: Automatisierung verfahrenstechnischer Prozesse: eine Einführung für Ingenieure und Techniker. München, Wien: Oldenbourg-Industrieverlag, 2002.
- Wellenreuther, G., Zastrow, D.: Automatisieren mit SPS: Theorie und Praxis. 4. Auflage, Wiesbaden: Vieweg+Teubner, 2009.

T 3.14 Course: Automotive Engineering I [T-MACH-100092]

Responsible: Prof. Dr. Frank Gauterin
Dr.-Ing. Hans-Joachim Unrau

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering
M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Expansion	Language	Version
Written examination	8	Each winter term	1 terms		3

Events					
WS 19/20	2113805	Automotive Engineering I	4 SWS	Lecture (V)	Gauterin, Unrau
WS 19/20	2113809	Automotive Engineering I	4 SWS	Lecture (V)	Gauterin, Gießler
Exams					
SS 2019	76-T-MACH-100092	Automotive Engineering		Prüfung (PR)	Gauterin, Unrau

Competence Certificate
Written examination

Duration: 120 minutes

Auxiliary means: none

Prerequisites
The brick "T-MACH-102203 - Automotive Engineering I" is not started or finished. The bricks "T-MACH-100092 - Grundlagen der Fahrzeugtechnik I" and "T-MACH-102203 - Automotive Engineering I" can not be combined.

Below you will find excerpts from events related to this course:

V Automotive Engineering I

2113805, WS 19/20, 4 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. History and future of the automobile

2. Driving mechanics: driving resistances and driving performance, mechanics of longitudinal and lateral forces, active and passive safety

3. Drive systems: combustion engine, hybrid and electric drive systems

4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)

5. Power transmission and distribution: drive shafts, cardon joints, differentials

Workload
regular attendance: 45 hours
self-study: 195 hours

Literature

1. Mitschke, M. / Wallentowitz, H.: Dynamik der Kraftfahrzeuge, Springer Vieweg, Wiesbaden 2014

2. Pischinger, S. / Seiffert, U.: Handbuch Kraftfahrzeugtechnik, Springer Vieweg, Wiesbaden 2016

3. Gauterin, F. / Unrau, H.-J. / Gnadler, R.: Script to the lecture 'Grundlagen der Fahrzeugtechnik I', KIT, Institute of Vehicle System Technology, Karlsruhe, annual update

V

Automotive Engineering I

2113809, WS 19/20, 4 SWS, Language: English, Open in study portal

Lecture (V)

Notes

In English language.

Learning Content

1. History and future of the automobile

2. Driving mechanics: driving resistances and driving performances, mechanics of longitudinal and lateral forces, active and passive safety

3. Drive systems: combustion engine, hybrid and electric drive systems

4. Transmission: clutches (e.g. friction clutch, visco clutch), transmission (e.g. mechanical transmission, hydraulic fluid transmission)

5.Power transmission and distribution: drive shafts, cardon joints, differentials

Workload

regular attendance: 45 hours
self-study: 195 hours

Literature

1. Robert Bosch GmbH: Automotive Handbook, 9th edition, Wiley, Chichister 2015

2. Onori, S. / Serrao, L: / Rizzoni, G.: Hybrid Electric Vehicles - Energy Management Strategies, Springer London, Heidelberg, New York, Dordrecht 2016

3. Reif, K.: Brakes, Brake Control and Driver Assistance Systems - Function, Regulation and Components, Springer Vieweg, Wiesbaden 2015

4. Gauterin, F. / Gießler, M. / Gnadler, R.: Script to the lecture 'Automotive Engineering I', KIT, Institute of Vehicle System Technology, Karlsruhe, annual update

T 3.15 Course: Automotive Engineering II [T-MACH-102117]

Responsible: Prof. Dr. Frank Gauterin
Dr.-Ing. Hans-Joachim Unrau

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering
M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2114835	Automotive Engineering II	2 SWS	Lecture (V)	Unrau
SS 2019	2114855	Automotive Engineering II	2 SWS	Lecture (V)	Gießler
Exams					
SS 2019	76-T-MACH-102117	Automotive Engineering II		Prüfung (PR)	Unrau, Gauterin

Competence Certificate
Written Examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Automotive Engineering II
2114835, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Chassis: Wheel suspensions (rear axles, front axles, kinematics of axles), tyres, springs, damping devices
2. Steering elements: Manual steering, servo steering, steer by wire
3. Brakes: Disc brake, drum brake, comparison of designs

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Heißing, B. / Ersoy, M.: Fahrwerkhandbuch: Grundlagen, Fahrdynamik, Komponenten, Systeme, Mechatronik, Perspektiven, Springer Vieweg, Wiesbaden, 2013

2. Breuer, B. / Bill, K.-H.: Bremsenhandbuch: Grundlagen - Komponenten - Systeme - Fahrdynamik, Springer Vieweg, Wiesbaden, 2017

3. Unrau, H.-J. / Gnadler, R.: Script to the lecture 'Grundlagen der Fahrzeugtechnik II', KIT, Institute of Vehicle System Technology, Karlsruhe, annual update

V Automotive Engineering II
2114855, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
In English language.

Learning Content

1. Chassis: Wheel suspensions (rear axles, front axles, kinematics of axles), tyres, springs, damping devices
2. Steering elements: Manual steering, servo steering, steer by wire
3. Brakes: Disc brake, drum brake, comparison of the designs

Literature
Elective literature:

1. Robert Bosch GmbH: Automotive Handbook, 9th Edition, Wiley, Chichester 2015
2. Heißing, B. / Ersoy, M.: Chassis Handbook - fundamentals, driving dynamics, components, mechatronics, perspectives, Vieweg+Teubner, Wiesbaden 2011
3. Gießler, M. / Gnadler, R.: Script to the lecture "Automotive Engineering II", KIT, Institut of Vehicle System Technology, Karlsruhe, annual update

T 3.16 Course: Automotive Vision [T-MACH-105218]

Responsible: Dr. Martin Lauer
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2138340	Automotive Vision	3 SWS	Lecture (V)	Lauer
Exams					
SS 2019	76-T-MACH-105218	Automotive Vision		Prüfung (PR)	Stiller, Lauer

Competence Certificate
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Automotive Vision
2138340, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lernziele (EN):

Machine perception and interpretation of the environment for the basis for the generation of intelligent behaviour. Especially visual perception opens the door to novel automotive applications. First driver assistance systems can already improve safety, comfort and efficiency in vehicles. Yet, several decades of research will be required to achieve an automated behaviour with a performance equivalent to a human operator. The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Machine vision, vehicle kinematics and advanced information processing techniques are presented to provide a broad overview on ßeeing vehicles'. Application examples from cutting-edge and future driver
assistance systems illustrate the discussed subjects.

Lehrinhalt (EN):

1. Driver assistance systems
2. Binocular vision
3. Feature point methods
4. Optical flow/tracking in images
5. Tracking and state estimation
6. Self-localization and mapping
7. Lane recognition
8. Behavior recognition

Arbeitsaufwand (EN): 120 hours

Learning Content
1. Driver assistance systems
2. Binocular vision
3. Feature point methods
4. Optical flow/tracking in images
5. Tracking and state estimation
6. Self-localization and mapping
7. Lane recognition
8. Behavior recognition

Workload
120 hours

T 3.17 Course: Basics of Technical Logistics [T-MACH-102163]

Responsible: Dr.-Ing. Martin Mittwollen
Jan Oellerich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	4

Events					
WS 19/20	2117095	Basics of Technical Logistics	6 SWS	Lecture / Practice (VÜ)	Mittwollen, Oellerich
Exams					
SS 2019	76-T-MACH-102163	Basics of Technical Logistics		Prüfung (PR)	Mittwollen

Competence Certificate
The assessment consists of a written exam (60 min.).

Prerequisites
none

Below you will find excerpts from events related to this course:

V Basics of Technical Logistics

2117095, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:
supplementary sheets,presentations, blackboard

Notes
lectures and practice; practice dates: look up ILIAS

Learning Content

- effect model of conveyor machines
- elements for the change of position and orientation
- conveyor processes
- identification systems
- drives
- mechanical behaviour of conveyors
- structure and function of conveyor machines
- elements of intralogistics
- sample applications and calculations in addition to the lectures inside practical lectures

Annotation
Basics knowledge of technical mechanics is preconditioned

Workload
presence: 48h
rework: 132h

Literature
Recommendations during lessons

T 3.18 Course: Behaviour Generation for Vehicles [T-MACH-105367]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Dr. Moritz Werling

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2138336	Behaviour Generation for Vehicles	2 SWS	Lecture (V)	Werling, Stiller
Exams					
SS 2019	76-T-MACH-105367	Behaviour Generation for Vehicles		Prüfung (PR)	Stiller

Competence Certificate
written examination

60 min.

Simple calculators are allowed, programmable or graphical ones are prohibited.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Behaviour Generation for Vehicles
2138336, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lernziele (EN):

Modern vehicle control systems like ABS or ESP transform the intention of the driver into a corresponding behaviour of the vehicle. This is achieved by compensating disturbances like a varying traction for example. Within the recent years, vehicles have been increasingly equipped with sensors that gather information about the environment (Radar, Lidar and Video for example). This enables the vehicles to generate an 'intelligent' behaviour and transform this behaviour into control signals for actors. Several so called 'driver assistance systems' have already achieved remarkable improvements as far as comfort, safety and efficiency are concerned. But nevertheless, several decades of research will be required to achieve an automated behaviour with a performance equivalent to a human operator ('the driver'). The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Information technology, control theory and kinematic aspects are treated to provide a broad overview over vehicle guidance. Application examples from cutting-edge and future driver assistance systems illustrate the discussed subjects.

Workload
120 hours

T 3.19 Course: Bioelectric Signals [T-ETIT-101956]

Responsible: Dr.-Ing. Axel Loewe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	2

Events					
SS 2019	2305264	Bioelectric Signals	2 SWS	Lecture (V)	Loewe
Exams					
SS 2019	7305264	Bioelectric Signals		Prüfung (PR)	Loewe

Competence Certificate
The examination is a written examination with a duration of 90 minutes.

T 3.20 Course: Biomechanics: design in nature and inspired by nature [T-MACH-105651]

Responsible: Prof. Dr. Claus Mattheck
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2181708	Biomechanics: Design in Nature and Inspired by Nature	3 SWS		Mattheck

Competence Certificate
Colloquium, ungraded.

Prerequisites
The number of participants is limited. Prior registration through ILIAS is necessary, In case of too many registrations, a selection (in accordance with SPO) will take place.
Before the registration in SP 26 (ME) or SP 01 (MSMT) the participation at the seminar must be confirmed.

Below you will find excerpts from events related to this course:

V Biomechanics: Design in Nature and Inspired by Nature
2181708, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes
* mechanics and growth laws of trees
* failure criteria and safety factors
* computer simulation of adaptive growth
* notches and damage case studies
* optimization inspired by nature
* structural shape optimization without computers
* universal shapes of nature
* fibre reinforces materials
* failure of trees, hillsides, dikes, walls and pipes

Learning Content
* mechanics and growth laws of trees
* failure criteria and safety factors
* computer simulation of adaptive growth
* notches and damage case studies
* optimization inspired by nature
* structural shape optimization without computers
* universal shapes of nature
* fibre reinforces materials
* failure of trees, hillsides, dikes, walls and pipes

Workload
regular attendance: 30 hours
self-study: 90 hours

T 3.21 Course: Biomedical Measurement Techniques I [T-ETIT-106492]

Responsible: Prof. Dr. Werner Nahm
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Events					
WS 19/20	2305269	Biomedical Measurement Techniques I	2 SWS	Lecture (V)	Nahm

Prerequisites
T-ETIT-101928 - Biomedizinische Messtechnik I darf weder begonnen noch abgeschlossen sein.

T 3.22 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I [T-MACH-100966]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2141864	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	2 SWS	Lecture (V)	Guber
Exams					
SS 2019	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I		Prüfung (PR)	Guber

Competence Certificate
written exam (75 Min.)

Prerequisites
none

Below you will find excerpts from events related to this course:

V BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I

Lecture (V)

2141864, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture script

Learning Content
Introduction into various microtechnical manufacturing methods: LIGA, Micro milling, Silicon Micromachining, Laser Microstructuring, µEDM, Metal-Etching
Biomaterials, Sterilisation.
Examples of use in the life science sector: basic micro fluidic strucutures: micro channels, micro filters, micromixers, micropumps, microvalves, Micro and nanotiter plates, Microanalysis systems (µTAS),
Lab-on-chip applications.

Annotation
The exam is held during the semester break. The date will be announced at the beginning of the semester.

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

M. Madou
Fundamentals of Microfabrication
Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

T 3.23 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II [T-MACH-100967]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2142883	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	2 SWS	Lecture (V)	Guber
Exams					
SS 2019	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II		Prüfung (PR)	Guber

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

Below you will find excerpts from events related to this course:

V BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II
2142883, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Lecture script

Learning Content
Examples of use in Life-Sciences and biomedicine: Microfluidic Systems:
LabCD, Protein Cristallisation
Microarrys
Tissue Engineering
Cell Chip Systems
Drug Delivery Systems
Micro reaction technology
Microfluidic Cells for FTIR-Spectroscopy
Microsystem Technology for Anesthesia, Intensive Care and Infusion
Analysis Systems of Person´s Breath
Neurobionics and Neuroprosthesis
Nano Surgery

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature

Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II;
Springer-Verlag, 1994

M. Madou
Fundamentals of Microfabrication

T 3.24 Course: BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III [T-MACH-100968]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2142879	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	2 SWS	Lecture (V)	Guber
Exams					
SS 2019	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III		Prüfung (PR)	Guber

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

Below you will find excerpts from events related to this course:

V BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III — Lecture (V)
2142879, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture script

Learning Content
Examples of use in minimally invasive therapy
Minimally invasive surgery (MIS)
Endoscopic neurosurgery
Interventional cardiology
NOTES
OP-robots and Endosystems
License of Medical Products and Quality Management

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature
Menz, W., Mohr, J., O. Paul: Mikrosystemtechnik für Ingenieure, VCH-Verlag, Weinheim, 2005

Buess, G.: Operationslehre in der endoskopischen Chirurgie, Band I und II;
Springer-Verlag, 1994

M. Madou
Fundamentals of Microfabrication

T 3.25 Course: Bionics for Engineers and Natural Scientists [T-MACH-102172]

Responsible: PD Dr. Hendrik Hölscher
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2142140	Bionics for Engineers and Natural Scientists	2 SWS	Lecture (V)	Hölscher, Walheim, Greiner
Exams					
SS 2019	76-T-MACH-102172	Bionics for Engineers and Natural Scientists		Prüfung (PR)	Hölscher
WS 19/20	76-T-MACH-102172	Bionics for Engineers and Natural Scientists		Prüfung (PR)	Hölscher

Competence Certificate
written or oral exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Bionics for Engineers and Natural Scientists
2142140, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Slides of the lectures

Notes
Bionics focuses on the design of technical products following the example of nature. For this purpose we have to learn from nature and to understand its basic design rules. Therefore, the lecture focuses on the analysis of the fascinating effects used by many plants and animals. Possible implementations into technical products are discussed in the end.

The students should be able analyze, judge, plan and develop biomimetic strategies and products.

Basic knowledge in physics and chemistry

lectures 30 h

self study 30 h

preparation for examination 30 h

The successfull attendence of the lecture is controlled by a written examination.

Learning Content
Bionics focuses on the design of technical products following the example of nature. For this purpose we have to learn from nature and to understand its basic design rules. Therefore, the lecture focuses on the analysis of the fascinating effects used by many plants and animals. Possible implementations into technical products are discussed in the end.

Workload
lectures 30 h

self study 30 h

preparation for examination 30 h

Literature

Werner Nachtigall: Bionik – Grundlagen und Beispiele für Ingenieure und Naturwissenschaftler. Springer-Verlag Berlin (2002), 2. Aufl.

T 3.26 Course: BUS-Controls [T-MACH-102150]

Responsible: Simon Becker
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2114092	BUS-Controls	2 SWS	Lecture (V)	Geimer, Daiß
Exams					
SS 2019	76T-MACH-102150	BUS-Controls		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-102150	BUS-Controls		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108889 must have been passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108889 - BUS-Controls - Advance must have been passed.

Recommendation
Basic knowledge of electrical engineering is recommended. Programming skills are also helpful.

The number of participants is limited. A registration in mandatory, the details will be announced on the webpages of the *Institute of Vehicle System Technology / Institute of Mobile Machines*. In case of too many applications, attendance will be granted based on pre-qualification.

Annotation
The students will get an overview of the theoretic and practical functioning of different bus systems.

After the practical oriented lessons the students will be able to visualize the communication structure of different applications, design basic systems and evaluate the complexity of programming of the complete system.
Hereunto the students program in the practical orientated lessons IFM-controllers using the programming environment CoDeSys.

Content:

- Knowledge of the basics of data communication in networks
- Overview of the operating mode of current field buses
- Explicit observation of the operating mode and application areas of CAN buses
- Practical programming of an example application (hardware is provided)

Literature:

- Etschberger, K.: Controller Area Network, Grundlagen, Protokolle, Bausteine, Anwendungen; München, Wien: Carl Hanser Verlag, 2002.
- Engels, H.: CAN-Bus - CAN-Bus-Technik einfach, anschaulich und praxisnah dargestellt; Poing: Franzis Verlag, 2002.

Below you will find excerpts from events related to this course:

V **BUS-Controls**
2114092, SS 2019, 2 SWS, Language: German, Open in study portal
Lecture (V)

Learning Content

- Knowledge of the basics of data communication in networks
- Overview of the operating mode of current field buses
- Explicit observation of the operating mode and application areas of CAN buses
- Practical programming of an example application (hardware is provided)

Annotation
The course will be replenished by interesting lectures of professionals.

Workload

- regular attendance: 21 hours
- self-study: 92 hours

Literature
Elective literature:

- Etschberger, K.: Controller Area Network, Grundlagen, Protokolle, Bausteine, Anwendungen; München, Wien: Carl Hanser Verlag, 2002.
- Engels, H.: CAN-Bus - CAN-Bus-Technik einfach, anschaulich und praxisnah dargestellt; Poing: Franzis Verlag, 2002.

T 3.27 Course: BUS-Controls - Advance [T-MACH-108889]

Responsible: Kevin Daiß
Prof. Dr.-Ing. Marcus Geimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

Exams				
SS 2019	76-T-MACH-108889	BUS-Controls - Advance	Prüfung (PR)	Geimer
WS 19/20	76-T-MACH-108889	BUS-Controls - Advance	Prüfung (PR)	Geimer

Competence Certificate
Creation of control program

Prerequisites
none

T 3.28 Course: CAD-NX Training Course [T-MACH-102187]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each term	2

Events					
SS 2019	2123357	CAD-NX training course	3 SWS	Practical course (P)	Ovtcharova, Mitarbeiter
WS 19/20	2123357	CAD-NX training course	2 SWS	Practical course (P)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102187	CAD-NX Training Course		Prüfung (PR)	Ovtcharova

Competence Certificate
Practical examination on CAD computer, duration: 60 min.

Prerequisites
None

Recommendation
Dealing with technical drawings is required.

Annotation
For the practical course compulsory attendance exists.

Below you will find excerpts from events related to this course:

V CAD-NX training course
2123357, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
The participant will learn the following knowledge:

- Overview of the functional range
- Introduction to the work environment of NX
- Basics of 3D-CAD modelling
- Feature-based modelling
- Freeform modelling
- Generation of technical drawings
- Assembly modelling
- Finite element method (FEM) and multi-body simulation (MBS) with NX

Annotation
For the practical course compulsory attendance exists.

Workload
Regular attendance: 35 hours,
Self-study: 12 hours

Literature
Practical course skript

V

CAD-NX training course

2123357, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content

The participant will learn the following knowledge:

- Overview of the functional range
- Introduction to the work environment of NX
- Basics of 3D-CAD modelling
- Feature-based modelling
- Freeform modelling
- Generation of technical drawings
- Assembly modelling
- Finite element method (FEM) and multi-body simulation (MBS) with NX

Annotation

For the practical course compulsory attendance exists.

Workload

Regular attendance: 35 hours,
Self-study: 12 hours

Literature

Practical course skript

T 3.29 Course: CAE-Workshop [T-MACH-105212]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	2

Events					
SS 2019	2147175	CAE-Workshop	3 SWS	Block (B)	Albers, Mitarbeiter
WS 19/20	2147175	CAE-Workshop	3 SWS	Block (B)	Albers, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105212	CAE-Workshop		Prüfung (PR)	Albers

Competence Certificate
Written test (with practical part on the computer), duration 60 min.

Prerequisites
None

Annotation
For a successful participation in the examination a continuous attendance at the workshop days is necessary. Limited number of participants. Selection is made according to a selection procedure.

Below you will find excerpts from events related to this course:

V CAE-Workshop
2147175, SS 2019, 3 SWS, Language: German, Open in study portal

Block (B)

Notes

- introduction to the finite element analysis (FEA)
- stess and modal analysis of finite element models using Abaqus/CAE as a preprocessor and Abaqus solver
- introduction to topology and shape optimization
- creation and calculation of various optimization models with the Abaqus optimization package

Workload
regular attendance: 31.5 h

self-study: 58 h

independent work with different software tools (supported by tutors and faculty stuff)

discussing and presenting results in small groups

V CAE-Workshop
2147175, WS 19/20, 3 SWS, Language: German, Open in study portal

Block (B)

Notes

- introduction to the finite element analysis (FEA)
- stess and modal analysis of finite element models using Abaqus/CAE as a preprocessor and Abaqus solver
- introduction to topology and shape optimization
- creation and calculation of various optimization models with the Abaqus optimization package

Workload
regular attendance: 31.5 h

self-study: 58 h

independent work with different software tools (supported by tutors and faculty stuff)

discussing and presenting results in small groups

T 3.30 Course: CATIA Advanced [T-MACH-105312]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2123380	CATIA advanced	3 SWS	Project (PRO)	Ovtcharova, Mitarbeiter
WS 19/20	2123380	Advanced CATIA	3 SWS	Project (PRO)	Ovtcharova, Mitarbeiter

Competence Certificate
Assessment of another type. Design project and written documentation in team work and final presentation. Grading: Project work 3/5, documentation 1/5 and presentation 1/5.

Prerequisites
none

Below you will find excerpts from events related to this course:

V CATIA advanced
2123380, SS 2019, 3 SWS, Language: German, Open in study portal

Project (PRO)

Learning Content

- Use of advanced CAD techniques and CATIA functionalities
- Management of data using the PLM system SmarTeam
- Design engineering with CAD
- Integration of partial solutions into the overall solution
- Ensuring the reusability of CAD models through parameterization and cataloging
- Validation, strength tests (FEM analysis)
- Kinematic simulation with the digital mockup (DMU Kinematics)
- Production with integrated CAM tool
- Animations
- Presentation of results at the end of the semester

Annotation
For the workshop compulsory attendance exists.

Workload
regular attendance: 21 hours, self-study: 35 hours

T 3.31 Course: CATIA CAD Training Course [T-MACH-102185]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each term	2

Events					
SS 2019	2123358	CATIA CAD training course	3 SWS	Practical course (P)	Ovtcharova, Mitarbeiter
WS 19/20	2123358	CATIA CAD training course	2 SWS	Practical course (P)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102185	CATIA CAD Training Course		Prüfung (PR)	Ovtcharova

Competence Certificate
Practical examination on CAD computer, duration: 60 min.

Prerequisites
None

Recommendation
Dealing with technical drawings is required.

Annotation
For the practical course attendance is compulsory.

Below you will find excerpts from events related to this course:

V CATIA CAD training course

Practical course (P)

2123358, SS 2019, 3 SWS, Language: German, Open in study portal

Learning Content
The participant will learn the following knowledge:

- Basics of CATIA such as user interface, handling etc.
- Production and processing of different model types
- Production of basic geometries and parts
- Generation of detailed drawings
- Integration of partial solutions in modules
- Working with constrains
- Strength analysis with FEM
- Kinematic simulation with DMU
- Dealing with CATIA Knowledgeware

Annotation
For the practical course attendance is compulsory.

Workload
Regular attendance: 35 hours,
self-study: 12 hours

Literature
practical course skript

V

CATIA CAD training course

2123358, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
The participant will learn the following knowledge:

- Basics of CATIA such as user interface, handling etc.
- Production and processing of different model types
- Production of basic geometries and parts
- Generation of detailed drawings
- Integration of partial solutions in modules
- Working with constrains
- Strength analysis with FEM
- Kinematic simulation with DMU
- Dealing with CATIA Knowledgeware

Annotation
For the practical course attendance is compulsory.

Workload
Regular attendance: 35 hours,
self-study: 12 hours

Literature
practical course skript

T 3.32 Course: Ceramic Matrix Composites [T-MACH-106722]

Responsible: Prof. Dr.-Ing. Dietmar Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Exams				
SS 2019	76-T-MACH-106722	Ceramic Matrix Composites	Prüfung (PR)	Koch

Competence Certificate
oral exam

T 3.33 Course: CFD in Power Engineering [T-MACH-105407]

Responsible: Dr. Ivan Otic
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130910	CFD for Power Engineering	2 SWS	Lecture (V)	Otic
Exams					
SS 2019	76-T-MACH-105407	CFD in Power Engineering		Prüfung (PR)	Otic
WS 19/20	76-T-MACH-105407	CFD in Power Engineering		Prüfung (PR)	Otic

Competence Certificate
Oral exam, 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V CFD for Power Engineering
2130910, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
This course is specified for both Bachelor and Master students, Mechanical, Power and Nuclear Engineering.

The course is aimed of giving the fundamental of Computational Fluid Dynamics (CFD) for energy technologies. Computational techniques for solving Navier-Stokes and Energy equations with emphasis on turbulent heat and mass transfer are introduced. Finite volume method and solution of systems of linear algebraic equations are discussed. Error control, accuracy and stability are discussed and demonstrated. Reynolds-Averaged-Navier-Stokes (RANS) equations and computation of turbulent flows are discussed and demonstrated. Explicit vs. implicit time stepping methods.
The course consists of both, a theoretical and a practical component. The former will deal with the derivations and properties of the methods and models for CFD. The practical part will make use of open source CFD computer program OpenFOAM to give a "hands on" insight into the simulation of turbulent flows.

Learning Content

The course is aimed of giving the fundamental of Computational Fluid Dynamics (CFD) for energy technologies. Starting from the basic physical phenomena equations an overview on computational methods and turbulence modeling is given.
The course consists of both, a theoretical and a numerical component. The former will deal with the derivations and properties of the methods and models for CFD. The numerical part will make use of open source CFD computer program OpenFOAM to give a "hands on" insight into the simulation of turbulent flows. After completing the course you should be able to establish a connection between theory and CFD modeling and simulation for energy applications.

Tentative Course Outline:
The weekly coverage might change as it depends on the progress of the class.
Content
1 Introduction: What is Computational Fluid Dynamics?
2 Governing Equations
3 Numerical Methods: Introduction
4 Numerical Methods: Finite Volume
5 Numerical Methods: Solution of ordinary differential equations
6 Numerical Methods: Convergence and numerical stability
7 Turbulence and Turbulence Modelling
8 Reynolds Averaged Navier-Stokes Simulation Approach
9 Heat Transfer

Annotation

CFD Project:

- Part of this class is performing CFD simulations of turbulent heat and mass transfer using open-source CFD software OpenFOAM
- After CFD analysis is completed students have to write a technical report
- Projects are to be performed individually or in teams of two but every student writes his own report
- The CFD analysis technical report is part of the final examination.

Workload

- regular attendance: 20 h
- tutorials: 20 h
- self-study: 80 h

Literature

Course note packet

Project package

An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H. Versteeg and
W. Malalasekra, 2007.

Ferziger, J; Peric, M.: Computational Methods for Fluid Dynamics, Springer 2002.

T 3.34 Course: CFD-Lab Using OpenFOAM [T-MACH-105313]

Responsible: Dr.-Ing. Rainer Koch
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2169459	CFD-Lab using OpenFOAM	3 SWS	Practical course (P)	Koch
Exams					
WS 19/20	76-T-MACH-105313	CFD-Lab Using Open Foam		Prüfung (PR)	Koch

Competence Certificate
Successful solution of problems

Prerequisites
none

Below you will find excerpts from events related to this course:

V CFD-Lab using OpenFOAM
2169459, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

- A CD containing the course material will be handed out to the students

Learning Content

- Introduction to using Open Foam
- Grid generation
- Boundary conditions
- Numerical errors
- Discretization schemes
- Turbulence models
- Two phase flow - spray
- Two Phase flow - Volume of Fluid method

Annotation

- Number of participants is limited
- Priority for students of the lecture "Numerische Simulation reagierender Zweiphasenströmungen" (Vorl.-Nr. 2169458)

Workload

- 5 days of 8 h = 40 h

Literature

- Documentation of Open Foam
- www.open foam.com/docs

T 3.35 Course: Chemical Fuels [T-CIWVT-110307]

Responsible: Prof. Dr. Reinhard Rauch
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-105100 - Courses of the Department of Chemical and Process Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2019	22331	Chemical Fuels (ENTECH)	2 SWS	Lecture (V)	Rauch
Exams					
SS 2019	7230020	Chemical Fuels		Prüfung (PR)	Rauch

Competence Certificate
Learning Control is an oral examination with a duration of about 20 minutes.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Chemical Fuels (ENTECH)

Lecture (V)

22331, SS 2019, 2 SWS, Language: English, Open in study portal

Description
Introduction to Chemical Fuels (resources, global and regional consumption, CO2 emissions, characterization of raw materials and products, overview of conversion processes; petroleum refining: characterization of crude oils and refinery products, physical separation processes, chemical conversion processes (cracking, hydrotreating, reforming, H2 production etc); liquid fuels from renewable sources (biomass, renewable electricity); gaseous fuels; gasification of solid fuels; economic aspects and perspectives.

T 3.36 Course: Chemical, Physical and Material Scientific Aspects of Polymers in Microsystem Technologies [T-MACH-102169]

Responsible: Dr.Ing. Matthias Worgull
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	3	Each term	1

Competence Certificate
The assessment will consist of a oral exam (30 min) (following §4 (2), 2 of the examination regulation).

Prerequisites
none

T 3.37 Course: Coal Fired Power Plants [T-MACH-105410]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169461	Coal fired power plants	2 SWS	Lecture (V)	Schulenberg

Competence Certificate
Oral examination, Duration approximately 30 Minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Coal fired power plants
2169461, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
This lecture will be omitted until further

T 3.38 Course: Cognitive Automobiles - Laboratory [T-MACH-105378]

Responsible: Bernd Kitt
Dr. Martin Lauer
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2138341	Cogitive Automobiles - Laboratory	3 SWS		Stiller, Lauer, Kamran

Competence Certificate
oral exam

30 minutes

Prerequisites
none

Annotation
The number of participants is limited. A registration is mandatory, the details are announced on the webpages of the institute of measurement and control systems (mrt). In case of too many interested students a subset will be selected (see website).

Below you will find excerpts from events related to this course:

V Cogitive Automobiles - Laboratory
2138341, SS 2019, 3 SWS, Language: German, Open in study portal

Notes
Lehrinhalt (EN):

1. Lane recognition
2. Object detection
3. Vehicle lateral control
4. Vehicle longitudinal control
5. Collision avoidance

Lernziele (EN):

The laboratory accompanies the lectures "Automotive Vision" and "Behaviour Generation for Vehicles". It will provide the opportunity of turning theoretical skills taught in the lecture to practice. The laboratory is divided into four groups with a maximum number of five students in each group. During the lessons you will be supervised by scientific staff.
The lecture addresses students in mechanical engineering and related subjects who intend to get an interdisciplinary knowledge in a state-of-the-art technical domain. Machine vision, vehicle kinematics and advanced information processing techniques are presented to provide a broad overview on "seeing vehicles". Each group is given the task to extract lane markings from video images and generate a suitable trajectory which the vehicle should follow. Apart from technical aspects in a highly innovative field of automotive technology, participants have the opportunity of gathering important qualifications as i.e. implementation skills, acquisition and comprehension of suitable literature, project and team work.

Learning Content
1. Lane recognition
2. Object detection
3. Vehicle lateral control
4. Vehicle longitudinal control
5. Collision avoidance

Workload
120 hours

3.39 Course: Cognitive Systems [T-INFO-101356]

Responsible: Prof. Dr.-Ing. Rüdiger Dillmann
Prof. Dr. Alexander Waibel
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	24572	Kognitive Systeme	4 SWS	Lecture / Practice (VÜ)	Dillmann, Waibel, Stüker, Meißner
Exams					
SS 2019	7500157	Cognitive Systems		Prüfung (PR)	Dillmann, Waibel

T 3.40 Course: Combined Cycle Power Plants [T-MACH-105444]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170490	Combined Cycle Power Plants	2 SWS	Lecture (V)	Schulenberg
Exams					
SS 2019	76-T-MACH-105444	Combined Cycle Power Plants		Prüfung (PR)	Schulenberg

Competence Certificate
oral exam ca. 30 min

Prerequisites
none

Recommendation
We recommend to combine the lecture with the Simulator Exercises for Combined Cycle Power Plants (T-MACH-105445).

Below you will find excerpts from events related to this course:

V Combined Cycle Power Plants
2170490, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
Media:

Lecture with English Power Point Presentation

Notes
The training objective of the course is the qualification for a research-related professional activity in power plant engineering. The participants can name the most important components of the combined cycle power plant and describe their function. They can design or modify combined cycle power plants independently and creatively. They have acquired a broad knowledge of this power plant technology, including specific knowledge of gas turbine design, steam turbine design and boiler design. On this basis, they can describe and analyze the specific behavior of the power plant components as well as the entire power plant in the grid. Participants in the lecture have a trained analytical thinking and judgment in power plant design.

Layout of a combined cycle power plant, design and operation of gas turbines, of the heat recovery steam generator, of the feedwater system and cooling systems. Design and operation of steam turbines, of the generator and its electrical systems. System response to challinging grids, protection systems, water make-up and water chemistry. Design concepts of different power plant manufacturers, innovative power plant concepts.

Learning Content
Layout of a combined cycle power plant, design and operation of gas turbines, of the heat recovery steam generator, of the feedwater system and cooling systems. Design and operation of steam turbines, of the generator and its electrical systems. System response to challinging grids, protection systems, water make-up and water chemistry. Design concepts of different power plant manufacturers, innovative power plant concepts.

Annotation

Recommendations: Knowlegde in thermodynamics, heat and mass transfer, instrumentation and control, and turbomachines is presumed.

We recommend to combine the lecture with the Simulator Exercises for Combined Cycle Power Plants (2170491)

Workload

Regular attendance: 32 hours

Self study: 88 hours

Literature

Power point slides and other lecture material will be provided.

Recommended additional literature:

C. Lechner, J. Seume, Stationäre Gasturbinen, Springer Verlag, 2. Auflage 2010

T 3.41 Course: Combustion Engines I [T-MACH-102194]

Responsible: Prof. Dr. Thomas Koch
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2133113	Combustion Engines I	4 SWS	Lecture / Practice (VÜ)	Koch
Exams					
SS 2019	76-T-MACH-102194	Combustion Engines I		Prüfung (PR)	Koch, Kubach
WS 19/20	76-T-MACH-102194	Combustion Engines I		Prüfung (PR)	Kubach, Koch

Competence Certificate
oral examination, Duration: 25 min., no auxiliary means

Prerequisites
none

Below you will find excerpts from events related to this course:

V Combustion Engines I
2133113, WS 19/20, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
Introduction, History, Concepts
Working Principle and Applications
Characteristic Parameters
Engine Parts
Drive Train
Fuels
Gasoline Engines
Diesel Engines
Exhaust Gas Aftertreatment

Learning Content
Introduction, History, Concepts
Working Principle and Applications
Characteristic Parameters
Engine Parts
Drive Train
Fuels
Gasoline Engines
Diesel Engines
Exhaust Gas Aftertreatment

Workload
regular attendance: 32 hours
self-study: 88 hours

T 3.42 Course: Combustion Engines II [T-MACH-104609]

Responsible: Dr.-Ing. Rainer Koch
Dr.-Ing. Heiko Kubach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	1

Events					
SS 2019	2134151	Combustion Engines II	3 SWS	Lecture / Practice (VÜ)	Koch
Exams					
SS 2019	76-T-MACH-104609	Combustion Engines II		Prüfung (PR)	Koch, Kubach
WS 19/20	76-T-MACH-104609	Combustion Engines II		Prüfung (PR)	Kubach, Koch

Competence Certificate
oral examination, duration: 25 minutes, no auxiliary means

Prerequisites
none

Recommendation
Fundamentals of Combustion Engines I helpful

Below you will find excerpts from events related to this course:

V Combustion Engines II
2134151, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content
Emissions

Fuels

Drive Train Dynamics

Engine Parts

Boosting

Alternative Powertrain Concepts

Special Engine Concepts

Power Transmission

Workload
regular attendance: 31,5 hours
self-study: 90 hours

T 3.43 Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-105535]

Responsible: Prof. Dr.-Ing. Frank Henning
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture (V)	Henning
Exams					
SS 2019	7600002	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies		Prüfung (PR)	
SS 2019	76-T-MACH-105535	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies		Prüfung (PR)	Henning

Competence Certificate
written exam 90 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Lecture (V)

2114053, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Physical connections of fiber reinforcement

Use and examples
automotive construction
transport
Energy and construction
sport and recreation

resins
thermoplastics
duromeres

mechanisms of reinforcements
glas fibers
carbon fibers
aramid fibers
natural fibers

semi-finished products - textiles

process technologies - prepregs

recycling of composites

Workload
lectures: 21h, preparation of examination: 79h

T 3.44 Course: Computational Dynamics [T-MACH-105349]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162246	Computational Dynamics	2 SWS		Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Computational Dynamics
2162246, SS 2019, 2 SWS, Open in study portal

Learning Content
1. Fundamentals of elasto-kinetics (Equations of motion, principle of Hamilton and principle of Hellinger-Reissner)
2. Differential equations for the vibration of structure elements (bars, plates)
3. Numerical solutions of the equations of motion
4. Numerical algorithms
5. Stability analyses

Annotation
The course takes place every two years (in pair years).

Workload
Lectures: 20 h

Self-studies: 100 h

Literature
1. Lecture notes (in German) will be provided!

2. M. Géradin, B. Rixen: Mechanical Vibrations, Wiley, Chichester, 1997

T 3.45 Course: Computational Homogenization on Digital Image Data [T-MACH-109302]

Responsible: Prof. Dr. Matti Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Expansion	Version
Oral examination	6	Each winter term	1 terms	1

Events					
WS 19/20	2161123	Computational homogenization on digital image data (Lecture)	2 SWS	Lecture (V)	Schneider
WS 19/20	2161124	Computational homogenization on digital image data (Tutorial)	2 SWS	Practice (Ü)	Wicht, Schneider

Competence Certificate
oral exam, 30 min

Prerequisites
nein

Below you will find excerpts from events related to this course:

V Computational homogenization on digital image data (Lecture)
Lecture (V)
2161123, WS 19/20, 2 SWS, Language: English, Open in study portal

Description
Contents of the lectures "Continuum Mechanics of Solids and Fluids" or "Mathematical Methods in Continuum Mechanics" are required

Notes
* Basic equations for computing effective elastic material properties
* Moulinec-Suquet's FFT-based computational homogenization method
* Schemes for treating highly contrasted/porous/defected media
* Treating non-linear and time dependent mechanical proplems

Learning Content
Contents:
* basic equations for computing effective elastic material properties
* Moulinec-Suquet's FFT-based computational homogenization method
* schemes for treating highly contrasted/porous/defected media
* treating non-linear and time dependent mechanical proplems

Workload
regular attendance: 42 hours (together with tutorial No 2161124)
self-study: 138 hours

Literature
Milton, G. W.: The Theory of Composites. Springer, New York, 2002

V Computational homogenization on digital image data (Tutorial)
Practice (Ü)
2161124, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes
Please refer to the lecture "Computational homogenization on digital image data".

T 3.46 Course: Computational Intelligence [T-MACH-105314]

Responsible: Dr. Wilfried Jakob
Prof. Dr. Ralf Mikut
PD Dr.-Ing. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2105016	Computational Intelligence	2 SWS	Lecture (V)	Mikut, Jakob, Reischl
Exams					
SS 2019	76-T-MACH-105314	Computational Intelligence		Prüfung (PR)	Mikut

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Computational Intelligence

2105016, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The students are able to apply the fundamental methods of computational intelligence (fuzzy logic, artificial neural networks, evolutionary algorithms) efficiently. They know the basic mathematical foundations and are able to transfer these methods to practical applications.

Content:

- Terms and definitions Computational Intelligence, application fields and examples
- Fuzzy logic: fuzzy sets; fuzzification and membership functions; inference: T-norms and -conorms, operators, aggregation, activation, accumulation; defuzzification methods, structures for fuzzy control
- Artificial Neural Nets: biology of neurons, Multi-Layer-Perceptrons, Radial-Basis-Function nets, Kohonen maps, training strategies (Backpropagation, Levenberg-Marquardt)
- Evolutionary Algorithms: Basic algorithm, Genetic Algorithms and Evolution Strategies, Evolutionary Algorithm GLEAM, integration of local search strategies, memetic algorithms, application examples

Learning objectives:

The students are able to apply the fundamental methods of computational intelligence (fuzzy logic, artificial neural networks, evolutionary algorithms) efficiently. They know the basic mathematical foundations and are able to transfer these methods to practical applications.

Learning Content

- Terms and definitions Computational Intelligence, application fields and examples
- Fuzzy logic: fuzzy sets; fuzzification and membership functions; inference: T-norms and -conorms, operators, aggregation, activation, accumulation; defuzzification methods, structures for fuzzy control
- Artificial Neural Nets: biology of neurons, Multi-Layer-Perceptrons, Radial-Basis-Function nets, Kohonen maps, training strategies (Backpropagation, Levenberg-Marquardt)
- Evolutionary Algorithms: Basic algorithm, Genetic Algorithms and Evolution Strategies, Evolutionary Algorithm GLEAM, integration of local search strategies, memetic algorithms, application examples

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
Lecture notes (ILIAS)

Kiendl, H.: Fuzzy Control. Methodenorientiert. Oldenbourg-Verlag, München, 1997

S. Haykin: Neural Networks: A Comprehensive Foundation. Prentice Hall, 1999

Kroll, A. Computational Intelligence: Eine Einführung in Probleme, Methoden und technische Anwendungen Oldenbourg Verlag, 2013

Blume, C, Jakob, W: GLEAM - General Learning Evolutionary Algorithm and Method: ein Evolutionärer Algorithmus und seine Anwendungen. KIT Scientific Publishing, 2009 (PDF frei im Internet)

H.-P. Schwefel: Evolution and Optimum Seeking. New York: John Wiley, 1995

Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe; 2008 (PDF frei im Internet)

T 3.47 Course: Computational Mechanics I [T-MACH-105351]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	2

Events					
WS 19/20	2161147	Computational Mechanics I (Tutorial)	2 SWS	Practice (Ü)	Erdle, Langhoff
WS 19/20	2161250	Computational Mechanics I	2 SWS	Lecture (V)	Langhoff, Böhlke
WS 19/20	2161312	Consultation hour Computational Mechanics I	2 SWS	Consultation-hour (Sprechst.)	Erdle, Langhoff

Competence Certificate
oral examination, 30 min.

Prerequisites
none

Recommendation
The contents of the lectures "Mathematical Methods in Strength of Materials" and "Introduction to the Finite Element Method" are assumed to be known

This course is geared to MSc students.

Below you will find excerpts from events related to this course:

V Computational Mechanics I (Tutorial) — Practice (Ü)

2161147, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Please refer to the lecture "Computational Mechanics I".

V Computational Mechanics I — Lecture (V)

2161250, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content

- numerical solution of linear systems
- basics of boundary value problems of linear elasticity
- solution methods of boundary value problem of linear elasticity;
- matrix displacement method
- variational principles of linear elasticity
- finite-element-technology for linear static problems

Workload
regular attendance: 42 hours
self-study: 138 hours

Literature

Simó, J.C.; Hughes, T.J.R.: Computational Inelasticity. Springer 1998.
Haupt, P.: Continuum Mechanics and Theory of Materials. Springer 2002.
Belytschko, T.; Liu,W.K.; Moran, B.: Nonlinear FE for Continua and Structures. JWS 2000.
W. S. Slaughter: The linearized theory of elasticity. Birkhäuser, 2002.
J. Betten: Finite Elemente für Ingenieure 2, Springer, 2004.

T 3.48 Course: Computational Mechanics II [T-MACH-105352]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2019	2162206	Sprechstunde zu Rechnerunterstützte Mechanik II	2 SWS	Consultation-hour (Sprechst.)	N.N.
SS 2019	2162296	Computational Mechanics II	2 SWS	Lecture (V)	Langhoff
SS 2019	2162297	Übungen zu 'Rechnerunterstützte Mechanik II'	2 SWS	Practice (Ü)	Langhoff, N.N.

Competence Certificate
oral examination, 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Computational Mechanics II
2162296, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- overview quasistatic nonlinear phenomena
- numerics of nonlinear systems
- foundations of nonlinear continuum mechanics
- balance equations of geometrically nonlinear solid mechanics
- finite elasticity
- infinitesimal plasicity
- linear and gemetrically nonlinear thermoelasticity

Workload
regular attendance: 42 hours
self-study: 138 hours

Literature
Simó, J.C.; Hughes, T.J.R.: Computational Inelasticity. Springer 1998.Haupt, P.: Continuum Mechanics and Theory of Materials. Springer 2002.Belytschko, T.; Liu,W.K.; Moran, B.: Nonlinear FE for Continua and Structures. JWS 2000.

T 3.49 Course: Computational Vehicle Dynamics [T-MACH-105350]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162256	Computational Vehicle Dynamics	2 SWS	Lecture (V)	Proppe
Exams					
WS 19/20	76-T-MACH-105350	Computational Vehicle Dynamics		Prüfung (PR)	Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Computational Vehicle Dynamics
2162256, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Introduction
2. Models of load bearing systems
3. Contact forces between wheels and roadway
4. Simulation of roadways
5. Vehicle models
6. Methods of calculation
7. Performance indicators

Annotation
The course takes place every two years (impair years only).

Workload
Lectures: 20 h

Self-studies: 100 h

Literature
1. K. Popp, W. Schiehlen: Fahrzeugdynamik, B. G. Teubner, Stuttgart, 1993
2. H.-P. Willumeit: Modelle und Modellierungsverfahren in der Fahrzeugdynamik, B. G. Teubner, Stuttgart, 1998
3. H. B. Pacejka: Tyre and Vehicle Dynamics. Butterworth Heinemann, Oxford, 2002
4. K. Knothe, S. Stichel: Schienenfahrzeugdynamik, Springer, Berlin, 2003

T 3.50 Course: Computer Engineering [T-MACH-105360]

Responsible: Dr. Hubert Keller
Dr.-Ing. Maik Lorch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2106002	Computer Engineering	2 SWS	Lecture (V)	Keller, Lorch
Exams					
SS 2019	76-T-MACH-105360	Computer Engineering		Prüfung (PR)	Keller, Lorch

Competence Certificate
written exam (Duration: 2 hours)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Computer Engineering **Lecture (V)**
2106002, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
Content:

Introduction: definitions, basic concepts, introductory examples

Information coding on finite automata: numbers, characters, commands, examples

Algorithm design: definitions, complexity of algorithms, complexity classes P and NP, examples

Sorting algorithms: relevance, algorithms, simplifications, examples

Software quality assurance: terms and measures, errors, phases of quality assurance, constructive measures, analytical measures, certification

Lectures are complemented by an exercice course.

Learning objectives:

The students possess essential knowledge about information processing in digital computers. Based on information representation and calculations of complexity, students are capable to design algorithms efficiently. The students are able to apply the knowledge about efficient algorithm design to important numerical computation methods in mechanical engineering. Students have basic knowledge of real-time systems and their development. Students can use the knowledge to develop real-time systems for reliable automation of technological systems in mechanical engineering.

Learning Content
Introduction: definitions, basic concepts, introductory examples

Information coding on finite automata: numbers, characters, commands, examples

Algorithm design: definitions, complexity of algorithms, complexity classes P and NP, examples

Sorting algorithms: relevance, algorithms, simplifications, examples

Software quality assurance: terms and measures, errors, phases of quality assurance, constructive measures, analytical measures, certification

Lectures are complemented by an exercice course.

Workload
regular attendance: 31,5 hours
self-study: 73,5 hours

Literature
Lecture Notes (Ilias)

Becker, B., Molitor, P.: Technische Informatik : eine einführende Darstellung. München, Wien : Oldenbourg, 2008.

Hoffmann, D. W.: Grundlagen der Technischen Informatik. München: Hanser, 2007.

Balzert, H.: Lehrbuch Grundlagen der Informatik : Konzepte und Notationen in UML, Java und C++, Algorithmik und Software-Technik, Anwendungen. Heidelberg, Berlin : Spektrum, Akad. Verl., 1999.

Trauboth, H.: Software-Qualitätssicherung : konstruktive und analytische Maßnahmen. München, Wien : Oldenbourg, 1993.

Ada Reference Manual, ISO/IEC 8652:2012(E), Language and Standard Libraries. Springer Heidelberg

Benra, J.; Keller, H.B.; Schiedermeier, G.; Tempelmeier, T.: Synchronisation und Konsistenz in Echtzeitsystemen. Benra, J.T. [Hrsg.] Software-Entwicklung für Echtzeitsysteme Berlin [u.a.] : Springer, 2009, S.49-65

Färber, G.:Prozeßrechentechnik. Springer-Lehrbuch. Springer; Auflage: 3., überarb. Aufl. (7. September 1994)

Leitfaden Informationssicherheit, IT-Grundschutz kompakt. Bundesamt für Sicherheit in der Informationstechnik – BSI53133 Bonn, 2012, BSI-Bro12/311

Cooling, J.: Software Engineering for Real Time Systems. Addison-Wesley, Pearson, Harlow, 2002.

Stallings, W.: Betriebssysteme. 4. Auflage. Pearson Studium, München, 2003.

Summerville, I.: Software Engineering. Pearson Studium, München, 2007.

T 3.51 Course: Computerized Multibody Dynamics [T-MACH-105384]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Competence Certificate
Oral exam, 30 min.

Prerequisites
none

Recommendation
Knowledge of EM III/IV

T 3.52 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

Responsible: Prof. Dr. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2177601	Constitution and Properties of Protective Coatings	2 SWS	Lecture (V)	Ulrich
Exams					
SS 2019	76-T-MACH-105150	Constitution and Properties of Protective Coatings		Prüfung (PR)	Ulrich

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

Below you will find excerpts from events related to this course:

V Constitution and Properties of Protective Coatings
2177601, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
oral examination (about 30 min); no tools or reference materials

Teaching Content:

introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

regular attendance: 22 hours
self-study: 98 hours

Transfer of the basic knowledge of surface engineering, of the relations between constitution, properties and performance, of the manifold methods of modification, coating and characterization of surfaces.

Learning Content
introduction and overview

concepts of surface modification

coating concepts

coating materials

methods of surface modification

coating methods

characterization methods

state of the art of industrial coating of tools and components

new developments of coating technology

Workload
regular attendance: 22 hours
self-study: 98 hours

Literature
Bach, F.-W.: Modern Surface Technology, Wiley-VCH, Weinheim, 2006

Copies with figures and tables will be distributed

T 3.53 Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

Responsible: Prof. Dr. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2194643	Constitution and Properties of Wear resistant materials	2 SWS	Lecture (V)	Ulrich
Exams					
SS 2019	76-T-MACH-102141	Constitution and Properties of Wearresistant Materials		Prüfung (PR)	Ulrich

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

Below you will find excerpts from events related to this course:

V Constitution and Properties of Wear resistant materials

2194643, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

Teaching Content:

introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

regular attendance: 22 hours
self-study: 98 hours

Basic understanding of constitution of wear-resistant materials, of the relations between constitution, properties and performance, of principles of increasing of hardness and toughness of materials as well as of the characteristics of the various groups of wear-resistant materials.

Learning Content
introduction

materials and wear

unalloyed and alloyed tool steels

high speed steels

stellites and hard alloys

hard materials

hard metals

ceramic tool materials

superhard materials

new developments

Workload
regular attendance: 22 hours
self-study: 98 hours

Literature
Laska, R. Felsch, C.: Werkstoffkunde für Ingenieure, Vieweg Verlag, Braunschweig, 1981

Schedler, W.: Hartmetall für den Praktiker, VDI-Verlage, Düsseldorf, 1988

Schneider, J.: Schneidkeramik, Verlag moderne Industrie, Landsberg am Lech, 1995

Copies with figures and tables will be distributed

3.54 Course: Contact Mechanics [T-MACH-105786]

Responsible: Dr. Christian Greiner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2181220	Contact Mechanics	2 SWS	Lecture (V)	Greiner

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowledge in mathematics, physics and materials science

Below you will find excerpts from events related to this course:

Contact Mechanics

2181220, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The course introduces contact mechanics of smooth and rough surface for non-adhesive and adhesive interfacial conditions. There will a computer lab held in parallel to the lecture that teaches numerical approaches to contact mechanical problems.

1. Introduction: contact area and stiffness
2. Theory of the elastic half-space
3. Contact of nonadhesive spheres: Hertz theory
4. Physics and chemistry of adhesive interactions at interfaces
5. Contact of adhesive spheres: theories of Johnson-Kendall-Roberts, Derjaguin-Muller-Toporov and Maugis-Dugdale
6. Surface roughness: topography, power spectral density, structure of real surfaces, fractal surfaces as a model, metrology
7. Contact of nonadhesive rough surfaces: theories of Greenwood-Williamson, Persson, Hyun-Pei-Robbins-Molinari
8. Contact of adhesive rough surface: theories of Fuller-Tabor, Persson and recent numerical results
9. Contact of rough spheres: theory of Greenwood-Tripp and recent numerical results
10. Lateral and sliding contact: theories of Cattaneo-Mindlin, Savkoor, Persson
11. Applications of contact mechanics

The student

- knows models for smooth and rough surfaces under non-adhesive and adhesive conditions and understands their strengths and limits
- knows fundamental scaling relations for the functional dependency between contact area, stiffness and normal force
- can apply numerical methods to study questions from materials science

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

Learning Content

The course introduces contact mechanics of smooth and rough surface for non-adhesive and adhesive interfacial conditions. There will a computer lab held in parallel to the lecture that teaches numerical approaches to contact mechanical problems.

1. Introduction: contact area and stiffness
2. Theory of the elastic half-space
3. Contact of nonadhesive spheres: Hertz theory
4. Physics and chemistry of adhesive interactions at interfaces
5. Contact of adhesive spheres: theories of Johnson-Kendall-Roberts, Derjaguin-Muller-Toporov and Maugis-Dugdale
6. Surface roughness: topography, power spectral density, structure of real surfaces, fractal surfaces as a model, metrology
7. Contact of nonadhesive rough surfaces: theories of Greenwood-Williamson, Persson, Hyun-Pei-Robbins-Molinari
8. Contact of adhesive rough surface: theories of Fuller-Tabor, Persson and recent numerical results
9. Contact of rough spheres: theory of Greenwood-Tripp and recent numerical results
10. Lateral and sliding contact: theories of Cattaneo-Mindlin, Savkoor, Persson
11. Applications of contact mechanics

Workload

regular attendance: 22,5 hours

self-study: 97,5 hours

Literature

K. L. Johnson, Contact Mechanics (Cambridge University Press, 1985)

D. Maugis, Contact, Adhesion and Rupture of Elastic Solids (Springer-Verlag, 2000)

J. Israelachvili, Intermolecular and Surface Forces (Academic Press, 1985)

T 3.55 Course: Control Technology [T-MACH-105185]

Responsible: Christoph Gönnheimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2150683	Control Technology	2 SWS	Lecture (V)	Gönnheimer
Exams					
SS 2019	76-T-MACH-105185	Control Technology		Prüfung (PR)	Fleischer

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Control Technology

2150683, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).

Notes
The lecture control technology gives an integral overview of available control components within the field of industrial production systems.
The first part of the lecture deals with the fundamentals of signal processing and with control peripherals in the form of sensors and actors which are used in production systems for the detection and manipulation of process states.
The second part handles with the function of electric control systems in the production environment. The main focus in this chapter is laid on programmable logic controls, computerized numerical controls and robot controls. Finally the course ends with the topic of cross-linking and decentralization with the help of bus systems.
The lecture is very practice-oriented and illustrated with numerous examples from different branches.

The following topics will be covered:

- Signal processing
- Control peripherals
- Programmable logic controls
- Numerical controls
- Controls for industrial robots
- Distributed control systems
- Field bus
- Trends in the area of control technology

Learning Outcomes:

The students ...

- are able to name the electrical controls which occur in the industrial environment and explain their function.
- can explain fundamental methods of signal processing. This involves in particular several coding methods, error protection methods and analog to digital conversion.
- are able to choose and to dimension control components, including sensors and actors, for an industrial application, particularly in the field of plant engineering and machine tools. Thereby, they can consider both, technical and economical issues.
- can describe the approach for projecting and writing software programs for a programmable logic control named Simatic S7 from Siemens. Thereby they can name several programming languages of the IEC 1131.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content
The lecture control technology gives an integral overview of available control components within the field of industrial production systems.
The first part of the lecture deals with the fundamentals of signal processing and with control peripherals in the form of sensors and actors which are used in production systems for the detection and manipulation of process states.
The second part handles with the function of electric control systems in the production environment. The main focus in this chapter is laid on programmable logic controls, computerized numerical controls and robot controls. Finally the course ends with the topic of cross-linking and decentralization with the help of bus systems.
The lecture is very practice-oriented and illustrated with numerous examples from different branches.

The following topics will be covered:

- Signal processing
- Control peripherals
- Programmable logic controls
- Numerical controls
- Controls for industrial robots
- Distributed control systems
- Field bus
- Trends in the area of control technology

Annotation
None

Workload
regular attendance: 21 hours
self-study: 99 hours

T 3.56 Course: Cooling of Thermally High Loaded Gas Turbine Components [T-MACH-105414]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Achmed Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170463	Cooling of thermally high loaded gas turbine components	2 SWS	Lecture (V)	Bauer, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105414	Cooling of Thermally High Loaded Gas Turbine Components		Prüfung (PR)	Bauer, Schulz

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Cooling of thermally high loaded gas turbine components

Lecture (V)

2170463, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Hot gas temperatures of modern gas turbine engines exceed the maximum tolerable material temperatures by several hundreds of K. To ensure reliability of lifetime, complex cooling technology must be applied. Various cooling methods will be introduced in this lesson. Specific pros and cons will be identified and new concepts for further improvement of cooling will be discussed. Furthermore, the fundamentals of forced convection heat transfer and film cooling wil be imparted and a simplified design process of a cooled gas turbine components will be demonstrated. Finally, experimental and numerical methods for the characterization of heat transfer will be presented.

Workload
regular attendance: 21 h
self-study: 42 h

T 3.57 Course: Data Analytics for Engineers [T-MACH-105694]

Responsible: Nicole Ludwig
Prof. Dr. Ralf Mikut
PD Dr.-Ing. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

Events					
SS 2019	2106014	Data Analytics for Engineers	3 SWS	Lecture / Practice (VÜ)	Mikut, Reischl, Ludwig
Exams					
SS 2019	76-T-MACH-105694	Datenanalyse für Ingenieure		Prüfung (PR)	Mikut, Reischl, Hagenmeyer

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Data Analytics for Engineers

2106014, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
Content:

- Introduction and motivation
- Terms and definitions (types of multidimensional features - time series and images, problem classes)
- Scenario: Problem formulation, feature extraction, evaluation, selection and transformation, distance measures, Bayes classifiers, Support-Vector-Machines, decision trees, clustering, regression, validation
- Biweekly computer exercises (Software practice with Gait-CAD): Data import, benchmark datasets, control of hand prostheses, energy prediction
- 2 hours per week lectures, 1 hour per week computer training

Learning objectives:

The students are able to apply the methods of data analysis efficiently. They know the basic mathematical data mining foundations for the analysis of single features and time series using classifiers, clustering and regression approaches. They are able to use various relevant methods as Bayes classifiers, Support Vector Machines, decision trees, fuzzy rulebases and they can adapt application scenarios (with data preprocessing and validation techniques) to real-world applications.

Learning Content

- Introduction and motivation
- Terms and definitions (types of multidimensional features - time series and images, problem classes)
- Scenario: Problem formulation, feature extraction, evaluation, selection and transformation, distance measures, Bayes classifiers, Support-Vector-Machines, decision trees, clustering, regression, validation
- Biweekly computer exercises (Software practice with Gait-CAD): Data import, benchmark datasets, control of hand prostheses, energy prediction
- 2 hours per week lectures, 1 hour per week computer training

Workload
regular attendance: 32 hours
self-study: 118 hours

Literature
Lecture notes (ILIAS)

Mikut, R.: Data Mining in der Medizin und Medizintechnik. Universitätsverlag Karlsruhe.

2008 (free PDF in the Internet)

Backhaus, K.; Erichson, B.; Plinke, W.; Weiber, R.: Multivariate Analysemethoden: Eine anwendungsorientierte Einführung. Berlin u.a.: Springer. 2000

Burges, C.: A Tutorial on Support Vector Machines for Pattern Recognition. Knowledge Discovery and Data Mining 2(2) (1998), S. 121–167

Tatsuoka, M. M.: Multivariate Analysis. Macmillan. 1988

Mikut, R.; Loose, T.; Burmeister, O.; Braun, S.; Reischl, M.: Dokumentation der MATLAB-Toolbox Gait-CAD. Techn. Ber., Forschungszentrum Karlsruhe GmbH. 2006 (Internet)

T 3.58 Course: Design and Development of Mobile Machines [T-MACH-105311]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Jan Siebert

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113079	Design and Development of Mobile Machines	2 SWS	Lecture (V)	Geimer, Siebert, Lehr, Geiger
Exams					
SS 2019	76-T-MACH-105311	Design and Development of Mobile Machines		Prüfung (PR)	Geimer
WS 19/20	76-T-MACH-105311	Design and Development of Mobile Machines		Prüfung (PR)	Geimer

Competence Certificate

The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

A registration is mandatory, the details will be announced on the webpages of the *Institute of Vehicle System Technology / Institute of Mobile Machines*. In case of too many applications, attendance will be granted based on pre-qualification.

The course will be replenished by interestung lectures of professionals from leading hydraulic companies.

Prerequisites

Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108887 must have been passed.

Modeled Conditions

The following conditions have to be fulfilled:

1. The course T-MACH-108887 - Design and Development of Mobile Machines - Advance must have been passed.

Recommendation

Knowledge in Fluid Power Systems (LV 2114093)

Annotation
After completion of the lecture, studens can:

- design working and travel drive train hydraulics of mobile machines and can derive characteristic key factors.
- choose and apply suitable state of the art designing methods succesfully
- analyse a mobile machines and break its structure down from a complex system to subsystems with reduced complexity
- identify and desrcibe interactions and links between subsystems of a mobile maschine
- present and document solutions of a technical problem according to R&D standards

The number of participants is limited.

Conent:

The working scenario of a mobile machine depends strongly on the machine itself. Highly specialised machines, e.g. pavers are also as common as universal machines with a wide range of applications, e.g. hydraulic excavators. In general, all mobile machines are required to do their intended work in an optimal way and satisfy various critera at the same time. This makes designing mobile machines to a great and interesting challenge. Nevertheless, usually key factors can be derived for every mobile machine, which affect all other machine parameters. During this lecture, those key factors and designing mobile machines accordingly will be adressed. To do so, an exemplary mobile machine will be discussed and designed in the lecture an as a semester project.

Literature:

See german recommendations

Below you will find excerpts from events related to this course:

V **Design and Development of Mobile Machines** **Lecture (V)**
2113079, WS 19/20, 2 SWS, Language: German, **Open in study portal**

Learning Content
Wheel loaders and excavators are highly specialized mobile machines. Their function is to detach, pick up and deposit materials near by. Significant size for dimensioning of the machines is the content of their standard shovel. In this lecture the main steps in dimensioning a wheel loader or excavator are beeing thought. This includes among others:

- Defining the size and dimensions,
- the dimensioning of the drive train,
- Determining the kinematics of the equipment,
- the dimension of the working hydraulics and
- Calculations of strength

The entire design process of these machines is strongly influenced by the use of standards and guidelines (ISO/DIN-EN). Even this aspect is dealt with.

The lecture is based on the knowledge from the fields of mechanics, strength of materials, machine elements, propulsion and fluid technique. The lecture requires active participation and continued collaboration.

Workload

- regular attendance: 21 hours
- self-study: 99 hours

Literature
None.

T 3.59 Course: Design and Development of Mobile Machines - Advance [T-MACH-108887]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Jan Siebert

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Completed coursework	0	Each term	1

Exams				
SS 2019	76-T-MACH-108887	Design and Development of Mobile Machines - Advance	Prüfung (PR)	Geimer
WS 19/20	76-T-MACH-108887	Design and Development of Mobile Machines - Advance	Prüfung (PR)	Geimer

Competence Certificate
Preparation of semester report

Prerequisites
none

T 3.60 Course: Design of Highly Stresses Components [T-MACH-105310]

Responsible: Prof. Dr.-Ing. Jarir Aktaa
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181745	Design of highly stresses components	2 SWS	Lecture (V)	Aktaa
Exams					
SS 2019	76-T-MACH-105310	Design of Highly Stresses Components		Prüfung (PR)	Aktaa

Competence Certificate
oral exam

Below you will find excerpts from events related to this course:

V Design of highly stresses components

2181745, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Contents of the lecture:

- rules of common design codes
- classical models for elasto-plasticity and creep
- lifetime rules for creep, fatigue and creep-fatigue interaction
- unified constitutive models for thermo-elasto-viscoplasticity
- continuum mechanical models for damage at high temperatures
- application of advanced material models in FE-codes

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

- R. Viswanathan, Damage Mechanisms and Life Assessment of High-Temperature Components, ASM International, 1989.
- Lemaitre, J.; Chaboche J.L.: Mechanics of Solid Materials, Cambridge University Press, Cambridge, 1990.

T 3.61 Course: Design with Plastics [T-MACH-105330]

Responsible: Markus Liedel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2174571	Design with Plastics	2 SWS	Lecture (V)	Liedel
Exams					
SS 2019	76-T-MACH-105330	Design with Plastics		Prüfung (PR)	Liedel

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Poly I

Below you will find excerpts from events related to this course:

V Design with Plastics **Lecture (V)**
2174571, SS 2019, 2 SWS, Language: German, Open in study portal

Notes

Structure and properties of plastics materials,

Processing of plastics,

Behavior of plastics under environmental impacts,

Classic strength dimensioning,

Geometric dimensioning,

Plastic appropriate design,

Failure examples,

Joining of plastic parts,

Supporting simulation tools,

Structural foams,

Plastics Technology trends.

learning objectives:

Students will be able to

- distinguish polymer compounds from other construction materials regarding chemical differences, thermal behavior and solid conditions.
- discuss main plastics processes regarding advantages and disadvantages of materials selection and part geometry design and to make appropriate selections.
- analyze complex application requirements concerning material impacts on strength and to use the classic dimensioning method specific to the application to evaluate the lifetime part strength limit.
- evaluate part tolerances and geometry by appropriate methods considering molding shrinkage, production tolerances, post shrinkage, heat expansion, swelling, elastic and creep deformation.
- design plastic specific joining geometries like snap fits, screw bosses, weld seams and film hinges.
- detect classic molding failures and understand potential causes as well as to reduce the probability of molding failures by defining an optimized design.
- understand benefits and limits of selected simulation tools in the plastic technology discipline (strength, deformation, filling, warpage).
- assess polymer classes and plastic part designs with respect to suitable recycling concepts and ecological consequences.

requirements:

none,

recommendation: Polymerengineering I

workload:

The workload for the lecture Design with Plastics is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Learning Content

Structure and properties of plastics materials,

Processing of plastics,

Behavior of plastics under environmental impacts,

Classic strength dimensioning,

Geometric dimensioning,

Plastic appropriate design,

Failure examples,

Joining of plastic parts,

Supporting simulation tools,

Structural foams,

Plastics Technology trends.

Workload

The workload for the lecture Design with Plastics is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Literature

Scriptum will be handed out during the lecture.
Recommended literature are provided in the lecture.

T 3.62 Course: Designing with Composites [T-MACH-108721]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Exams				
SS 2019	76-T-MACH-108721	Designing with Composites	Prüfung (PR)	

Competence Certificate
Oral exam, 20 minutes

Prerequisites
None

Annotation
The lecture notes are made available via ILIAS.

T 3.63 Course: Development of Oil-Hydraulic Powertrain Systems [T-MACH-105441]

Responsible: Isabelle Ays
Dr.-Ing. Gerhard Geerling
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113072	Development of Oil-Hydraulic Powertrain Systems	2 SWS	Block (B)	Geerling, Becker
Exams					
WS 19/20	76-T-MACH-105441	Development of Oil-Hydraulic Powertrain Systems		Prüfung (PR)	Geimer

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Development of Oil-Hydraulic Powertrain Systems
2113072, WS 19/20, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
Place and time see institute homepage

Learning Content
The bloc course offered by the Chair of Mobile Machines (Mobima) conveys the basics of planning and development of mobile and industrial hydrostatic systems. The lecturer works for a market leading company producing fluid power drives and controls and gives a deep view into the process of planning and development using real life examples. The contents of the course are:

- marketing, project planning
- hydrostatic circuits
- heat balance, hydraulic accumulators
- filtration, noise lowering
- development exercises + laboratory tutorial

Workload

- regular attendance: 19 hours
- self-study: 90 hours

T 3.64 Course: Digital Control [T-MACH-105317]

Responsible: Dr.-Ing. Michael Knoop
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2137309	Digital Control	2 SWS	Lecture (V)	Knoop
Exams					
SS 2019	76-T-MACH-105317	Digital Control		Prüfung (PR)	Stiller
WS 19/20	76-T-MACH-105317	Digital Control		Prüfung (PR)	Stiller

Competence Certificate
written exam

60 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Digital Control
2137309, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lehrinhalt (EN):

1. Introduction into digital control:
Motivation for digital implementation of controllers Structure of digital feedback control loops Sample and hold units
2. State space analysis and design:
Discretisation of continuous-time systems Discrete-time state space equations Stability - definition and criteria State feedback design by eigenvalue assignment PI state feedback controller Luenberger observer, separation theorem
Systems with dead-time Deadbeat design
3. Analysis and design based on z-transform: z-transform - definition and theorems Control loop description in the z domain Stability criteria Root locus controller design Transfer of continuous-time controllers into discrete-time controllers

Voraussetzungen (EN):

Basic studies and preliminary examination; basic lectures in automatic control

Lernziele (EN):

The lecture intoduces key methods for the analysis and design of digital feedback control systems. Starting point is the discretisation of linear, continuous-time models. State space based and z-transform based controller design techniques are presented for discrete-time, single-input single-output systems. Furthermore, plants with dead-time and deadbeat design are covered.

Learning Content
1. Introduction into digital control:
Motivation for digital implementation of controllers Structure of digital feedback control loops Sample and hold units
2. State space analysis and design:
Discretisation of continuous-time systems Discrete-time state space equations Stability - definition and criteria State feedback design by eigenvalue assignment PI state feedback controller Luenberger observer, separation theorem
Systems with dead-time Deadbeat design
3. Analysis and design based on z-transform: z-transform - definition and theorems Control loop description in the z domain Stability criteria Root locus controller design Transfer of continuous-time controllers into discrete-time controllers

Workload
120 hours

Literature

- Lunze, J.: Regelungstechnik 2, 3. Auflage, Springer Verlag, Berlin Heidelberg 2005
- Unbehauen, H.: Regelungstechnik, Band 2: Zustandsregelungen, digitale und nichtlineare Regelsysteme. 8. Auflage, Vieweg Verlag, Braunschweig 2000
- Föllinger, O.: Lineare Abtastsysteme. 4. Auflage, R. Oldenbourg Verlag, München Wien 1990
- Ogata, K.: Discrete-Time Control Systems. 2nd edition, Prentice-Hall, Englewood Cliffs 1994
- Ackermann, J.: Abtastregelung, Band I, Analyse und Synthese. 3. Auflage, Springer Verlag, Berlin Heidelberg 1988

T 3.65 Course: Digital microstructure characterization and modeling [T-MACH-110431]

Responsible: Prof. Dr. Matti Schneider
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Competence Certificate
oral examination

T 3.66 Course: Digital Technology [T-ETIT-101918]

Responsible: Prof. Dr.-Ing. Jürgen Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	1

Events					
WS 19/20	2311615	Digital Technology	3 SWS	Lecture (V)	Becker
WS 19/20	2311617	Tutorial for 2311615 Digital Technology	1 SWS	Practice (Ü)	Kempf
Exams					
SS 2019	7311615	Digital Technology		Prüfung (PR)	Becker

Prerequisites
none

T 3.67 Course: Dimensioning and Optimization of Power Train System [T-MACH-105536]

Responsible: Prof. Dr.-Ing. Albert Albers
Dr.-Ing. Hartmut Faust
Dr. Eckhard Kirchner
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2146208	Dimensioning and Optimization of Power Train System	2 SWS	Lecture (V)	Faust
Exams					
SS 2019	7600001	Dimensioning and Optimization of Power Train System		Prüfung (PR)	Faust

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Dimensioning and Optimization of Power Train System

Lecture (V)

2146208, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

1. Architectures: conventional, hybrid and electrical transmissions
2. The gear as system in a vehicle
3. Components and power flow ofsynchromesh gears
4. Spur gears
5. Synchronization
6. Switching systems for vehicles with manual transmission
7. Actuators
8. Comfort aspects for manual transmissions
9. Torque converter
10. Planetary sets
11. Power conversion in automatic transmissions
12. Continuously variable transmission systems
13. Differentials and components for power split
14. Drive train for commercial vehicles
15. Gears and electrical machines for electro mobility

Workload
regular attendance: 21 h

self-study: 99 h

T 3.68 Course: Do it! – Service-Learning for prospective mechanical engineers [T-MACH-106700]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	1

Events					
WS 19/20	2109039	Do it! – Service-Learning for prospective mechanical engineers	2 SWS	Seminar (S)	Deml

Competence Certificate
Active and regular participation (compulsory attendance) in all appointments; no marking.

Prerequisites
Timely enrollment in ILIAS; limited number of participants.

Below you will find excerpts from events related to this course:

V Do it! – Service-Learning for prospective mechanical engineers

Seminar (S)

2109039, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The course combines university learning with social engagement. The students leave the well-known academic working conditions and apply engineering skills (such as the ergonomic workplace design) within a social institution.

The course will take place every two weeks with each session lasting three hours. A part of the course will not be held at KIT, but at a workshop for persons with disabilities.

1) Introductory session

Technical and generic preparation of the work assignment

2) Work assignment (3 sessions)

Getting to know the working conditions in a workshop for persons with disabilities and conducting a work analysis in small groups

3) Interim review session

Sharing about the experiences

4) Implementation phase (2 sessions)

Implementing improvement measures concerning workplace/-process design in small groups

5) Evaluation session

Evaluating and reflecting as well as transfering and integrating the new experiences in their student and working life

Learning target:

The aim of this course is to enable students to get to know different social living and working conditions (such as a workshop for persons with disabilities), to engage in society as prospective mechanical engineers, and in doing so to develop their personality.

The overall goal is to learn by service for people, which again is an important factor for client-oriented behavior. This kind of experience and action oriented learning by social engagement is also called "service-learning". This is supposed to encourage students' willingness to change their perspective and to achieve some level of understanding for other living and working conditions in order to enhance their social skills such as empathy, communication skills, individual initiative, and conflict management as well as to support self-organized learning.

This course is carried out in cooperation with external partners; the concept also exists at other universities *(http://www.agentur-mehrwert.de/de/hochschulen/do-it-studierendenprojekte.html).*

Literature
Course material will be provided in ILIAS.

T 3.69 Course: Drive Systems and Possibilities to Increase Efficiency [T-MACH-105451]

Responsible: Dr.-Ing. Hans-Peter Kollmeier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Competence Certificate
Oral examination, time duration 30 min., no aids

Prerequisites
none

T 3.70 Course: Drive Train of Mobile Machines [T-MACH-105307]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Marco Wydra

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113077	Drive Train of Mobile Machines	2 SWS	Lecture (V)	Geimer, Herr
WS 19/20	2113078	Übung zu 'Antriebsstrang mobiler Arbeitsmaschinen'	1 SWS	Practice (Ü)	Geimer, Herr
Exams					
SS 2019	76-T-MACH-105307	Drive Train of Mobile Machines		Prüfung (PR)	Geimer

Competence Certificate
The final assessment will be an oral examination (20 min) taking place during the recess period. The examination will be offered in ervery semester and can be repeated at any regular examination date.

Prerequisites
none

Recommendation

- General principles of mechanicals engineering
- Basic knowledge of hydraulics
- Interest in mobile machinery

Annotation
At the end of the lecture, participants can explain the structure and function of all discussed drive trains of mobile machines. They can analyze complex gearbox schematics and synthesize simple transmission functions using rough calculations.

Content:

In this course the different drive trains of mobile machinery will be discussed. The focus of this course is:

- mechanical gears
- torque converter
- hydrostatic drives
- power split drives
- electrical drives
- hybrid drives
- axles
- terra mechanics

Media: projector presentation

Literature: Download of lecture slides from ILIAS. Further literature recommendations during lectures.

Below you will find excerpts from events related to this course:

V Drive Train of Mobile Machines

Lecture (V)

2113077, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

projector presentation

Learning Content
In this course will be discussed the different drive train of mobile machinerys. The fokus of this course is:
- improve knowledge of fundamentals
- mechanical gears
- torque converter
- hydrostatic drives
- continuous variable transmission
- eletrical drives
- hybrid drives
- axles
- terra mechanic

Workload

- regular attendance: 21 hours
- self-study: 89 hours

Literature
download of scriptum via ILIAS

T 3.71 Course: Dynamics of the Automotive Drive Train [T-MACH-105226]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	1

Events					
WS 19/20	2163111	Dynamics of the Automotive Drive Train	2 SWS	Lecture (V)	Fidlin
WS 19/20	2163112	Übungen zu Dynamik des Kfz-Antriebsstrangs	2 SWS	Practice (Ü)	Fidlin, Yüzbasioglu

Competence Certificate
Oral examination, 30 min.

Prerequisites
none

Recommendation
Powertrain Systems Technology A: Automotive SystemsMachine DynamicsVibration Theory

Below you will find excerpts from events related to this course:

V Dynamics of the Automotive Drive Train

2163111, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- Main components of the vehicle powertrain and their modelling
- Typical driving situations
- Problemoriented models for particular driving situations
- System analysis and optimization with respect to dynamic behavior

Workload
time of attendance: 39 h
self-study: 201 h

Literature

- Dresig H. Schwingungen mechanischer Antriebssysteme, 2. Auflage, Springer, 2006
- Pfeiffer F., Mechanical System Dynamics, Springer, 2008
- Laschet A., Simulation von Antriebssystemen:Modellbildung der Schwingungssysteme und Beispiele aus der Antriebstechnik, Springer, 1988

T 3.72 Course: Electric Energy Systems [T-ETIT-101923]

Responsible: Prof. Dr.-Ing. Thomas Leibfried
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	1

Events					
SS 2019	2307391	Electric Energy Systems	2 SWS	Lecture (V)	Leibfried
SS 2019	2307393	Übungen zu 2307391 Elektroenergiesysteme	1 SWS	Practice (Ü)	Görtz
Exams					
SS 2019	7307391	Electric Energy Systems		Prüfung (PR)	Leibfried

Prerequisites
none

T 3.73 Course: Electric Rail Vehicles [T-MACH-102121]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114346	Electric Rail Vehicles	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-102121	Electrical Railway Traction Systems		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-102121	Electric Rail Vehicles		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Electric Rail Vehicles
2114346, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Introduction: history of electric traction in railway vehicles, economic impact
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
4. Electric drives: purpose of electric drive and basic configurations, traction motors (induction machine, synchronous machine with permanent magnets), drives for vehicles at dc and ac lines, drives for vehicle without contact wire, hybrids, conventional drives for existing vehicles
5. Train control management system: definitions, networks, bus systems, components, examples
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line
7. Traction power supply: dc and ac networks, energy management, design aspects

Learning Content

1. Introduction: history of electric traction in railway vehicles, economic impact
2. Wheel-rail-contact: carrying of vehicle mass, adhesion, current return
3. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
4. Electric drives: traction motors, power conversion, drives for vehicles at dc and ac lines, dieselelectric vehicles, multi system vehicles, axle drives, transmission of tractive effort to the rails
5. Train control management system: definitions, networks, bus systems, components, examples
6. Vehicle concepts: modern vehicle concepts for mass transit and electric main line
7. Traction power supply: networks, substations, inductive power supply, energy management

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

T 3.74 Course: Electrical Engineering and Electronics [T-ETIT-108386]

Responsible: Dr.-Ing. Klaus-Peter Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	8	Each winter term	1

Events					
WS 19/20	2306350	Electrical Engineering and Electronics for Mechanical Engineers	4 SWS	Lecture (V)	Stahl
WS 19/20	2306351	Tutorial for 2306339 Electrical Engineering and Electronics for Mechanical Engineers	2 SWS	Practice (Ü)	Stahl
Exams					
SS 2019	7306350	Electrical Engineering and Electronics for Mechanical Engineers		Prüfung (PR)	Becker

Competence Certificate
Written exam, duration 3 hours.

Prerequisites
none

Annotation
Exam will be held in english language.

T 3.75 Course: Electrical Machines [T-ETIT-100807]

Responsible: Dr.-Ing. Klaus-Peter Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Version
Oral examination	4	1

Exams				
SS 2019	7306315	Electrical Machines	Prüfung (PR)	Doppelbauer

T 3.76 Course: Electrical Machines and Power Electronics [T-ETIT-101954]

Responsible: Dr.-Ing. Klaus-Peter Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	1

Events					
SS 2019	2306307	Electrical Machines and Power Electronics	2 SWS	Lecture (V)	Hiller
SS 2019	2306309	Übungen zu 2306307 Elektrische Maschinen und Stromrichter	2 SWS	Practice (Ü)	Hiller
Exams					
SS 2019	7306307	Electrical Machines and Power Electronics		Prüfung (PR)	Braun

Prerequisites
none

T 3.77 Course: Electronic Devices and Circuits [T-ETIT-109318]

Responsible: Prof. Dr. Michael Siegel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Expansion	Version
Written examination	6	Each summer term	1 terms	2

Events					
SS 2019	2312655	Electronic Devices and Circuits	3 SWS	Lecture (V)	Siegel
SS 2019	2312657	Übungen zu 2312655 Elektronische Schaltungen	1 SWS	Practice (Ü)	Dörner
SS 2019	2312658	Tutorien zu 2312655 Elektronische Schaltungen	2 SWS		Wünsch
Exams					
SS 2019	7312655	Electronic Devices and Circuits		Prüfung (PR)	Siegel
WS 19/20	7312655	Electronic Devices and Circuits		Prüfung (PR)	Siegel

Prerequisites
none

T 3.78 Course: Energy and Process Technology I [T-MACH-102211]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Dr.-Ing. Corina Schwitzke
Dr. Amin Velji
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Written examination	9	Each winter term	1

Events					
WS 19/20	2157961	Energy and Process Technology I	6 SWS	Lecture / Practice (VÜ)	Wirbser, Bauer, Mitarbeiter, Wagner
Exams					
SS 2019	76-T-MACH-102211	Energy and Process Technology I		Prüfung (PR)	Bauer, Wirbser, Schwitzke

Competence Certificate
The assessment consists of a written exam (120 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites
none

Below you will find excerpts from events related to this course:

V Energy and Process Technology I
2157961, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
The last thrid of the lecture deals with the topic **Thermal Turbomachinery**. The basic principles, the functionality and the scope of application of gas and steam tubrines for the generation of electrical power and propulsion technology are addressed.

Learning Content
The last thrid of the lecture deals with the topic **Thermal Turbomachinery**. The basic principles, the functionality and the scope of application of gas and steam tubrines for the generation of electrical power and propulsion technology are addressed.

T 3.79 Course: Energy and Process Technology II [T-MACH-102212]

Responsible: Dr.-Ing. Corina Schwitzke
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Written examination	9	Each summer term	1

Events					
SS 2019	2170832	Energy and Process Technology II	6 SWS	Lecture / Practice (VÜ)	Schwitzke, Wirbser, Pritz
Exams					
SS 2019	76-T-MACH-102212	Energy and Process Technology II		Prüfung (PR)	Wirbser, Schwitzke, Bauer

Competence Certificate
The assessment consists of a written exam (120 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites
none

Below you will find excerpts from events related to this course:

V Energy and Process Technology II
2170832, SS 2019, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content
Thermal Turbomaschinery - In the first part of the lecture deals with energy systems. Questions regarding global energy resources and their use, especially for the generation and provision of electrical energy, are addressed. Common fossile and nuclear power plants for the centralized supply with electrical power as well as concepts of power-heat cogeneration for the decentralized electrical power supply by means of block-unit heat and power plants, etc. are discussed. Moreover, the characteristics and the potential of renewable energy conversion concepts, such as wind and hydro-power, photovoltaics, solar heat, geothermal energy and fuel cells are compare and evaluated. The focus is on the description of the potentials, the risks and the economic feasibility of the different strategies aimed to protect resources and reduce CO2 emissions.

T 3.80 Course: Energy Conversion and Increased Efficiency in Internal Combustion Engines [T-MACH-105564]

Responsible: Prof. Dr. Thomas Koch
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2133121	Energy Conversion and Increased Efficiency in Internal Combustion Engines	2 SWS	Lecture (V)	Koch
Exams					
SS 2019	76-T-MACH-105564	Energy Conversion and Increased Efficiency in Internal Combustion Engines		Prüfung (PR)	Koch, Kubach
WS 19/20	76-T-MACH-105564	Energy Conversion and Increased Efficiency in Internal Combustion Engines		Prüfung (PR)	Koch

Competence Certificate
oral exam, 25 minutes, no auxillary means

Prerequisites
none

Below you will find excerpts from events related to this course:

V Energy Conversion and Increased Efficiency in Internal Combustion Engines
Lecture (V)
2133121, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
1. Introduction
2. Thermodynamics of combustion engines
3. Fundamentals
4. gas exchange
5. Flow field
6. Wall heat losses
7. Combustion in gasoline engines
8. Pressure Trace Analysis
9. Combustion in Diesel engines
10. Waste heat recovery

Learning Content

1. Introduction
2. Thermodynamics of combustion engines
3. Fundamentals
4. gas exchange
5. Flow field
6. Wall heat losses
7. Combustion in gasoline engines
8. Pressure Trace Analysis
9. Combustion in Diesel engines
10. Waste heat recovery

Workload

regular attendance: 24 hours, self-study: 96 hours

T 3.81 Course: Energy demand of buildings – fundamentals and applications, with building simulation exercises [T-MACH-105715]

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2158203	Energy demand of buildings – fundamentals and applications, with building simulation exercises	4 SWS	Lecture / Practice (VÜ)	Schmidt
Exams					
WS 19/20	76-T-MACH-105715	Energy demand of buildings – fundamentals and applications, with building simulation exercises		Prüfung (PR)	Schmidt

Competence Certificate
oral exam, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Energy demand of buildings – fundamentals and applications, with building simulation exercises

Lecture / Practice (VÜ)

2158203, SS 2019, 4 SWS, Language: German, Open in study portal

Notes

- Selected topics of building physics regarding energy demand of buildings for heating and cooling
- Occupants' comfort in buildings
- Ventilation demand and ventilation concepts
- The passive house concept
- Passive use of solar energy in buildings
- Passive systems / concepts for cooling of buildings
- Exergetic evaluation of building systems
- Heat transfer systems to rooms for heating and cooling, "low-ex" systems
- Numerical methods in building simulation
- Generation of load series, simulation of technical building equipment

Learning outcomes:

The students know the influencing factors on the energy demand of buildings. They know the requirements and prerequisites for low energy and passive houses. They are familiar with methods for setting up energy balances for buildings and the relevant technical building equipment. Students are able to judge under which circumstances zero-energy or plus-energy buildings (with respect to the annual primary energy balance) are attainable. They know the requirements and criteria for occupants' comfort in buildings and they are able to estimate the influence of different renovation and retrofit measures on the energy demand and occupants' comfort. They know use cases and limits of different heat transfer systems for heating and cooling of rooms and are familiar with low exergy concepts for building energy systems.
Through integrated computer exercises, students learn to set up energy models of buildings, perform simulations and sensitivity analysis using these models and to evaluate and present their results.

Exam conditions:

- Project work as prerequisite for oral exam (solution of assigned building simulation task, including presentation in front of class)
- Mode of examination: oral (30 min.)
- Conditions: Cannot be combined with the following courses:
- Building Simulation [2157109]

Learning Content

- Selected topics of building physics regarding energy demand of buildings for heating and cooling
- Occupants' comfort in buildings
- Ventilation demand and ventilation concepts
- The passive house concept
- Passive use of solar energy in buildings
- Passive systems / concepts for cooling of buildings
- Exergetic evaluation of building systems
- Heat transfer systems to rooms for heating and cooling, "low-ex" systems
- Numerical methods in building simulation
- Generation of load series, simulation of technical building equipment

Literature

same as in German, no English version of book by Pehnt (ed.) available)

T 3.82 Course: Energy Market Engineering [T-WIWI-107501]

Responsible: Prof. Dr. Christof Weinhardt
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	4,5	Each summer term	1

Events					
SS 2019	2540464	Energy Market Engineering	2 SWS	Lecture (V)	Weinhardt, Staudt
SS 2019	2540465	Übung zu Energy Market Engineering	1 SWS	Practice (Ü)	Staudt, vom Scheidt
Exams					
SS 2019	79852	Energy Market Engineering		Prüfung (PR)	Weinhardt

Competence Certificate
The assessment consists of a written exam (60 min) (according to §4(2), 1 of the examination regulations). By successful completion of the exercises (§4 (2), 3 SPO 2007 respectively §4 (3) SPO 2015) a bonus can be obtained. If the grade of the written exam is at least 4.0 and at most 1.3, the bonus will improve it by one grade level (i.e. by 0.3 or 0.4).

Prerequisites
None

Recommendation
None

Annotation
Former course title until summer term 2017: T-WIWI-102794 "eEnergy: Markets, Services, Systems".

The lecture has also been added in the IIP Module *Basics of Liberalised Energy Markets*.

Below you will find excerpts from events related to this course:

V Energy Market Engineering

2540464, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
This lecture discusses different design options for electricity markets. We will focus on different approaches of nodal and zonal pricing as well as single price mechanisms and capacity markets. After a short recap of German and European market designs, the different design options will be discussed scientifically and with the help of examples. Furthermore, we will evaluate alternative market design options like microgrids. Besides the fundamental functioning of those markets, we will introduce and discuss methodological knowledge to evaluate market design options.

Annotation
The lecture has also been added in the IIP Module *Basics of Liberalised Energy Markets*.

Workload
The total workload for this course is approximately 135.0 hours. For further information see German version.

Literature

- Erdmann G, Zweifel P. *Energieökonomik, Theorie und Anwendungen*. Berlin Heidelberg: Springer; 2007.
- Grimm V, Ockenfels A, Zoettl G. Strommarktdesign: Zur Ausgestaltung der Auktionsregeln an der EEX *. *Zeitschrift für Energiewirtschaft*. 2008:147-161.
- Stoft S. *Power System Economics: Designing Markets for Electricity*. IEEE; 2002.,
- Ströbele W, Pfaffenberger W, Heuterkes M. *Energiewirtschaft: Einführung in Theorie und Politik*. 2nd ed. München: Oldenbourg Verlag; 2010:349.

T 3.83 Course: Energy Storage and Network Integration [T-MACH-105952]

Responsible: Dr.-Ing. Wadim Jäger
Prof. Dr. Robert Stieglitz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189487	Energy Storage and Grid Integration	2 SWS	Lecture (V)	Jäger, Stieglitz
Exams					
SS 2019	76-T-MACH-105952	Energiespeicher und Netzintegration		Prüfung (PR)	Jäger, Stieglitz
WS 19/20	76-T-MACH-105952	Energiespeicher und Netzintegration		Prüfung (PR)	Jäger, Stieglitz

Competence Certificate
oral exam, about 30 minutes

Prerequisites
The courses T-MACH-105952 Energiespeicher und Netzintegration and T-ETIT-104644 - Energy Storage and Network Integration can not be combined.

Below you will find excerpts from events related to this course:

V Energy Storage and Grid Integration
2189487, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The lecture provides an overview of the different storage types and their fundamental integration into the power supply grid.

Thereby, within the scope of this lecture, the necessity and the motivation for converting and storing energy will be given. Starting from the definition of fundamental terms different physical and chemical storage types along with their theoretical and practical basis are described. In particular, the decoupling of energy production and energy consumption, and the provision of different energy scales (time, power, density) will be discussed. Furthermore, the challenge of energy transport and re-integration into the different grid types is considered.

Students understand the different types of energy storage and apply their knowledge for the selection and principal dimensioning of relevant energy storage tasks.

Furthermore, students can reflect the state-of-the-art of most important energy storage types, their fundamental characterisitics and viability at given boundary conditions and they are enabled to elaborate and apply basic integration issues dependent on the grid structure for the different network types.

Oral exam, duration approximately 30 min, tools: non

Learning Content
The lecture provides an overview of the different storage types and their fundamental integration into the power supply grid.

Thereby, within the scope of this lecture, the necessity and the motivation for converting and storing energy will be given. Starting from the definition of fundamental terms different physical and chemical storage types along with their theoretical and practical basis are described. In particular, the decoupling of energy production and energy consumption, and the provision of different energy scales (time, power, density) will be discussed. Furthermore, the challenge of energy transport and re-integration into the different grid types is considered.

T 3.84 Course: Energy Systems I: Renewable Energy [T-MACH-105408]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2129901	Energy Systems I - Renewable Energy	3 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105408	Energy Systems I: Renewable Energy		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105408	Energy Systems I: Renewable Energy		Prüfung (PR)	Dagan

Competence Certificate
oral exam, 1/2 hour

Prerequisites
none

Below you will find excerpts from events related to this course:

V Energy Systems I - Renewable Energy
2129901, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

The student knows the principles of the feasibility of energy gain by means of renewable energies, in particular the solar energy.

regular attendance: 34 hours
self-study: 146 hours

Oral examination – as an elective course 30 minutes, in combination with Energiesysteme-II or other courses within the energy courses, as a major course 1 hour

Learning Content
The course deals with fundamental aspects of renewable energies.

1. The first part deals with the basic concepts of absorbing solar beans, in an efficient manner accounting for the minimization of heat losses. In this context, selective topics on thermodynamics as well as fluid dynamics are introduced. In the second part few applications are discussed and optimizations techniques of solar collectors construction and their heat transfer are presented.
2. The use of solar energy as a source for heat generation is followed by the idea of electricity generation. Introductive aspects of Photovoltaic technologies are illuminated.
3. The last part presents additional regenerative energy sources such as wind and geothermal energy.

Workload
regular attendance: 34 hours
self-study: 146 hours

T 3.85 Course: Energy systems II: Reactor Physics [T-MACH-105550]

Responsible: Dr. Aurelian Florin Badea
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130929	Energy systems II: Reactor Physics	2 SWS	Lecture (V)	Badea
Exams					
SS 2019	76-T-MACH-105550	Energy Systems II: Reactor Physics		Prüfung (PR)	Badea
WS 19/20	76-T-MACH-105550	Energy Systems II: Reactor Physics		Prüfung (PR)	Badea

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Energy systems II: Reactor Physics
2130929, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
nuclear fission & fusion,

radioactive decay, neutron excess, fission, fast and
thermal neutrons, fissile and fertile nuclei,

neutron flux, cross section, reaction rate, mean free path,
chain reaction, critical size, moderation,

reactor dynamics,

transport- and diffusion-equation for the neutron flux distribution,
power distributions in reactor,

one-group and two-group theories,

light-water reactors,

reactor safety,

design of nuclear reactors,

breeding processes,

nuclear power systems of generation IV

Literature
Dieter Schmidt, Reaktortechnik, Band 1: Grundlagen, ISBN 3 7650 2003 6

Dieter Schmidt, Reaktortechnik, Band 2: Anwendungen, ISBN 3 7650 2004 4

T 3.86 Course: Engine Laboratory [T-MACH-105337]

Responsible: Dr.-Ing. Uwe Wagner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2134001	Engine Laboratory	2 SWS	Practical course (P)	Wagner
Exams					
SS 2019	76-T-MACH-105337	Engine Laboratory		Prüfung (PR)	Koch

Competence Certificate
written documentation of every experiment, certificate of successful attendance, no grading

Prerequisites
none

Below you will find excerpts from events related to this course:

V Engine Laboratory
2134001, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
5 engine experiments in up-to-date development projects

Workload
regular attendance: 40 hours
self-study: 80 hours

Literature
Description of experiments

T 3.87 Course: Engine Measurement Techniques [T-MACH-105169]

Responsible: Dr.-Ing. Sören Bernhardt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134137	Engine measurement techniques	2 SWS	Lecture (V)	Bernhardt
Exams					
WS 19/20	76-T-MACH-105169	Engine Measurement Techniques		Prüfung (PR)	Koch

Competence Certificate
oral examination, Duration: 0,5 hours, no auxiliary means

Prerequisites
none

Recommendation
T-MACH-102194 Combustion Engines I

Below you will find excerpts from events related to this course:

V Engine measurement techniques
2134137, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Students get to know state-of-the-art measurement techniques for combustion engines. In particular basic techniques for measuring engine operating parameters such as torque, speed, power and temperature.

Possible measurement errors and abberations are discussed.

Furthermore techniques for measuring exhaust emissions, air/fuel ratio, fuel consumption as well as pressure indication for thermodynamic analysis are covered.

Workload
regular attendance: 21 hours
self-study: 100 hours

Literature

1. Grohe, H.:Messen an Verbrennungsmotoren
2. Bosch: Handbuch Kraftfahrzeugtechnik
3. Veröffentlichungen von Firmen aus der Meßtechnik
4. Hoffmann, Handbuch der Meßtechnik
5. Klingenberg, Automobil-Meßtechnik, Band C

T 3.88 Course: Entrepreneurship [T-WIWI-102864]

Responsible: Prof. Dr. Orestis Terzidis
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	3	Each term	1

Events					
SS 2019	2545001	Entrepreneurship	2 SWS	Lecture (V)	Terzidis, Mitarbeiter
Exams					
SS 2019	7900002	Entrepreneurship		Prüfung (PR)	Terzidis
SS 2019	7900192	Entrepreneurship		Prüfung (PR)	Terzidis

Competence Certificate
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites
None

Recommendation
None

Below you will find excerpts from events related to this course:

V Entrepreneurship
2545001, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
This lecture, as an obligatory part of the module “Entrepreneurship”, introduces basic concepts of entrepreneurship. It approaches the individual steps of dynamic corporate development. The focus here is the introduction to methods for generating innovative business ideas, the translation of patents into business concepts and general principles of business planning.
Other topics are the design and use of service-oriented information systems for founders, technology management, business model generation and lean startup methods for the implementation of business ideas in the way of controlled experiments in the market.

Learning Content
This lecture, as an obligatory part of the module "Entrepreneurship", introduces basic concepts of entrepreneurship. It approaches the individual steps of dynamic corporate development. The focus here is the introduction to methods for generating innovative business ideas, the translation of patents into business concepts and general principles of financial planning.
Other topics are the design and use of service-oriented information systems for founders, technology management, business model generation and lean startup methods for the implementation of business ideas in the way of controlled experiments in the market.

Workload
The total workload for this course is approximately 90 hours. For further information see German version.

T 3.89 Course: Excercises - Fatigue of Welded Components and Structures [T-MACH-109304]

Responsible: Dr. Majid Farajian
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	1

Events					
WS 19/20	2181731	Fatigue of Welded Components and Structures	2 SWS	Block (B)	Farajian, Gumbsch

Competence Certificate
successful solving of all exercises

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fatigue of Welded Components and Structures

2181731, WS 19/20, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

The student can

- describe the influence of welding induced notches, defects and residual stresses on component behavior
- explain the basics of numerical and experimental methods for the evaluation of statically or cyclically loaded welds explain and can apply them
- derive measures in order to increase the lifetime of structures with welded joints under cyclical load

preliminary knowlegde materials science and mechanics recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

Exercise sheets are handed out regularly.

oral examination (ca. 30 min)

no tools or reference materials

Learning Content
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

1. D. Radaj, C.M. Sonsino and W. Fricke, Fatigue assessment of welded joints by local approaches, Second edition.Woodhead Publishing, Cambridge 2006.
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009

T 3.90 Course: Excercises in Technical Thermodynamics and Heat Transfer I [T-MACH-105204]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Completed coursework (written)	0	Each winter term	1

Events					
WS 19/20	2165502	Exercise course Technical Thermodynamics and Heat Transfer I	2 SWS	Practice (Ü)	Maas
WS 19/20	3165015	Technical Thermodynamics and Heat Transfer I (Tutorial)	2 SWS	Tutorial (Tu)	Schießl, Maas
Exams					
SS 2019	76-T-MACH-105204	Excercises in Technical Thermodynamics and Heat Transfer I		Prüfung (PR)	Maas

Competence Certificate
Homework is mandatory.

T 3.91 Course: Excercises in Technical Thermodynamics and Heat Transfer II [T-MACH-105288]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

Events					
SS 2019	2166556	Technical Thermodynamics and Heat Transfer II (Tutorial)	2 SWS	Practice (Ü)	Maas
SS 2019	3166033	Technical Thermodynamics and Heat Transfer II (Tutorial)	2 SWS	Practice (Ü)	Schießl, Maas
Exams					
SS 2019	76-T-MACH-105288	Excercises in Technical Thermodynamics and Heat Transfer II		Prüfung (PR)	Maas

Competence Certificate
Homework is mandatory.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technical Thermodynamics and Heat Transfer II (Tutorial)
Practice (Ü)

2166556, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Calculation of thermodynamical problems

Workload
Regular attendance: 21,0 hours
Self-stuy: 28 hours

Literature
Course notes
Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.
Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

T 3.92 Course: Exercices - Tribology [T-MACH-109303]

Responsible: Prof. Dr. Martin Dienwiebel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Expansion	Version
Completed coursework	0	Each winter term	1 terms	1

Events					
WS 19/20	2181114	Tribology	5 SWS	Lecture / Practice (VÜ)	Dienwiebel, Scherge
Exams					
SS 2019	76-T-MACH-109303	Exercices - Tribology		Prüfung (PR)	Dienwiebel

Competence Certificate
successful solving of all exercises

Prerequisites
none

Below you will find excerpts from events related to this course:

V Tribology
2181114, WS 19/20, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

Workload
regular attendance: 45 hours
self-study: 195 hours

Literature

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In:Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

T 3.93 Course: Exercises for Applied Materials Simulation [T-MACH-107671]

Responsible: Prof. Dr. Peter Gumbsch
Dr. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	2	Each summer term	2

Events					
SS 2019	2182614	Applied Materials Modelling	4 SWS	Lecture / Practice (VÜ)	Schulz, Gumbsch
Exams					
SS 2019	76-T-MACH-107671	Exercises for Applied Materials Simulation		Prüfung (PR)	Schulz

Competence Certificate
successful solving of all exercises

Prerequisites
none

Below you will find excerpts from events related to this course:

V Applied Materials Modelling

2182614, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

black board, beamer, script, computer exercise

Notes
This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

The student can

- define different numerical methods and distinguish their range of application
- approach issues by applying the finite element method and discuss the processes and results
- understand complex processes of metal forming and crash simulation and discuss the structural and material behavior
- define and apply the physical fundamentals of particle-based simulation techniques to applications of materials science
- illustrate the range of application of atomistic simulation methods and distinguish between different models

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

oral exam ca. 35 minutes

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content
This lecture should give the students an overview of different simulation methods in the field of materials science and engineering. Numerical methods are presented and their use in different fields of application and size scales shown and discussed. On the basis of theoretical as well as practical aspects, a critical examination of the opportunities and challenges of numerical material simulation shall be carried out.

Workload
regular attendance: 34 hours

exercise: 11 hours

self-study: 165 hours

Literature

1. D. Frenkel, B. Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press, 2001
2. W. Kurz, D.J. Fisher: Fundamentals of Solidification, Trans Tech Publications, 1998
3. P. Haupt: Continuum Mechanics and Theory of Materials, Springer, 1999
4. M. P. Allen, D. J. Tildesley: Computer simulation of liquids, Clarendon Press, 1996

T 3.94 Course: Exercises for Materials Characterization [T-MACH-107685]

Responsible: Dr.-Ing. Jens Gibmeier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	3

Events					
WS 19/20	2174586	materials characterization	2 SWS	Lecture (V)	Schneider, Gibmeier
Exams					
SS 2019	76-T-MACH-107685	Exercises for Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier
WS 19/20	76-T-MACH-107685	Exercises for Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier

Competence Certificate
Regular attendance

Prerequisites
none

Below you will find excerpts from events related to this course:

V materials characterization

Lecture (V)

2174586, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

learning objectives:
The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.
requirements:
none
workload:

The workload for the module "Materials Characterization" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Learning Content
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

Workload
The workload for the module "Materials Characterization" is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Literature
Lecture notes (will be provided at the beginning of the lecture).

Literature will be announced at the beginning of the lecture.

T 3.95 Course: Exercises for Solid State Reactions and Kinetics of Phase Transformations [T-MACH-107632]

Responsible: Dr. Peter Franke
Prof. Dr. Hans Jürgen Seifert
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	2	Each winter term	3

Events					
WS 19/20	2193004	Exercises for Solid State Reactions and Kinetics of Phase Transformations	1 SWS	Practice (Ü)	Franke, Ziebert

Competence Certificate
successful processing of exercises

Prerequisites
none

Below you will find excerpts from events related to this course:

V Exercises for Solid State Reactions and Kinetics of Phase Transformations
2193004, WS 19/20, 1 SWS, Language: German, Open in study portal

Practice (Ü)

Notes
1. Fick's laws of diffusion

2. Calculation of diffusion coefficients

3. Diffusion and solidification

Recommendations: Lecture in Solid State Reactions and Kinetics of Phase Transformations; Basic course in materials science and engineering; physical chemistry

Reinforcement of the lecture by the solution of practical and lecture-relevant exercises

Learning Content
1. Fick's laws of diffusion

2. Calculation of diffusion coefficients

3. Diffusion and solidification

Workload
regular attendance: 14 hours

self-study: 46 hours

Literature
Lecture notes

T 3.96 Course: Experimental Dynamics [T-MACH-105514]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	1

Events					
SS 2019	2162225	Experimental Dynamics	3 SWS	Lecture (V)	Fidlin
SS 2019	2162228	Übungen zu Experimentelle Dynamik	2 SWS	Practice (Ü)	Fidlin, Aramendiz Fuentes

Competence Certificate
oral exam, 30 min.

Prerequisites
Can not be combined with Practical Training in Measurement of Vibrations (T-MACH-105373).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105373 - Practical Training in Measurement of Vibrations must not have been started.

Below you will find excerpts from events related to this course:

V Experimental Dynamics
2162225, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

1. Introduction
2. Measurement principles
3. Sensors as coopled multi-physical systems
4. Digital signal processing, measurements in frequency domain
5. Forced non-linear vibrations
6. Stability problems (Mathieu oscillator, friction induces vibrations)
7. Elementary rotor dynamics
8. Modal analysis

Annotation
The lectures will be accompanied by the laboratory experiments

Workload
time of attendance: 29 h
self-study: 121 h

T 3.97 Course: Experimental Fluid Mechanics [T-MACH-105512]

Responsible: Dr. Jochen Kriegseis
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154446	Experimental Fluid Mechanics	2 SWS	Lecture (V)	Kriegseis
WS 19/20	2153530	Experimental Fluid Mechanics	2 SWS	Lecture (V)	Kriegseis
Exams					
SS 2019	76-T-MACH-105512	Experimental Fluid Mechanics		Prüfung (PR)	Kriegseis
WS 19/20	76-T-MACH-105512	Experimental Fluid Mechanics		Prüfung (PR)	Kriegseis

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Experimental Fluid Mechanics
2154446, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Slides, chalk board, overhead

Learning Content
This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Workload
regular attendance: 19,5 hours
self-study: 100,5 hours

Literature
Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

V Experimental Fluid Mechanics

2153530, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description

Media:

Slides, chalk board, overhead

Notes

The students can describe the relevant physical principles of experimental fluid mechanics. They are qualified to comparatively discuss the introduced measurement techniques. Furthermore, they are able to distinguish (dis-)advantages of the respective approaches. The students can evaluate and discuss measurment signal and data obtained with the common fluid mechanical measuring techniques.

This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Learning Content

This lecture focuses on experimental methods of fluid mechanics and their application to solve flow problems of practical relevance. In addition, measurement signals and data, obtained with the discussed measuring techniques, are evaluated, presented and discussed.

The lecture covers a selection of the following topics:

- measuring techniques and measureable quantities
- measurements in turbulent flows
- pressure measurements
- hot wire measurements
- optical measuring techniques
- error analysis
- scaling laws
- signal and data evaluation

Workload

regular attendance: 19,5 hours
self-study: 100,5 hours

Literature

Tropea, C., Yarin, A.L., Foss, J.F.: Springer Handbook of Experimental Fluid Mechanics, Springer 2007

Spurk, J.H.:Fluid Mechanics, Springer, 1997

T 3.98 Course: Experimental Lab Class in Welding Technology, in Groups [T-MACH-102099]

Responsible: Dr.-Ing. Stefan Dietrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	2

Events					
WS 19/20	2173560	Welding Lab Course, in groupes	3 SWS	Practical course (P)	Dietrich, Schulze

Competence Certificate
Certificate to be issued after evaluation of the lab class report.

Prerequisites
Certtificate of attendance for Welding technique (The participation in the course Welding Technology I/II is assumed.).

Annotation
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

Below you will find excerpts from events related to this course:

V Welding Lab Course, in groupes
2173560, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

learning objectives: The students are capable to name a survey of current welding processes and their suitability for joining different metals. The students can evaluate the advantages and disadvantages of the individual procedures. The students have weld with different welding processes.

requirements:

Certificate to be issued after evaluation of the lab class report
You need sturdy shoes and long clothes!

workload:

regular attendance: 31,5 hours
preparation: 8,5 hours
lab report: 80 hours

Learning Content

Gas welding of steels with different weld geometries

Gas welding of cast iron, nonferrous metals

Brazing of aluminum

Electric arc welding with different weld geometries

Gas welding according to the TIG, MIG and MAG procedures

Annotation

The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period in the secretariat of the Institute of Applied Materials (IAM – WK). The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

Workload

regular attendance: 31,5 hours
preparation: 8,5 hours
lab report: 80 hours

Literature

distributed during the lab attendance

T 3.99 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]

Responsible: Dr. Klaus Bade
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture (V)	Bade
WS 19/20	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture (V)	Bade
Exams					
SS 2019	76-T-MACH-102166	Fabrication Processes in Microsystem Technology		Prüfung (PR)	Bade

Competence Certificate
Oral examination, 20 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fabrication Processes in Microsystem Technology

2143882, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

pdf files of presentation sheets

Learning Content
The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included

Literature
M. Madou
Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
2nd Edition, ACS, Washington DC, 1994

V

Fabrication Processes in Microsystem Technology

2143882, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description

Media:

pdf files of presentation sheets

Learning Content

The lecture offers an advanced understanding of manufacturing processes in microsystem technology. Basic aspects of microtechnological processing will be introduced. With examples from semiconductor microfabrication and microsystem technology the base processing steps for conditioning and finishing, patterning, removal are imparted. Nano-patterning is covered is also included and the micro-nano interface is discussed. By the help of typical processing steps elementary mechanisms, process execution, and equipment are explained. Additionally quality control, process control and environmental topics are included

Literature

M. Madou
Fundamentals of Microfabrication

CRC Press, Boca Raton, 1997

W. Menz, J. Mohr, O. Paul

Mikrosystemtechnik für Ingenieure

Dritte Auflage, Wiley-VCH, Weinheim 2005

L.F. Thompson, C.G. Willson, A.J. Bowden
Introduction to Microlithography
2nd Edition, ACS, Washington DC, 1994

T 3.100 Course: Failure Analysis [T-MACH-105724]

Responsible: Dr. Christian Greiner
Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2182572	Failure Analysis	2 SWS	Lecture (V)	Greiner, Schneider
Exams					
SS 2019	76-T-MACH-105724	Failure Analysis		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-105724	Failure Analysis		Prüfung (PR)	Schneider

Competence Certificate
oral examination, ca. 30 min

Prerequisites
none

Recommendation
basic knowledge in materials science (e.g. lecture materials science I and II)

Below you will find excerpts from events related to this course:

V Failure Analysis

2182572, WS 19/20, 2 SWS, Open in study portal

Lecture (V)

Notes
Aim, procedure and content of examining failure

Examination methods

Types of failure:
Failure due to mechanical loads
Failure due to corrosion in electrolytes
Failure due to thermal loads
Failure due to tribological loads

Damage systematics

The students are able to discuss damage evaluation and to perform damage investigations. They know the common necessary investigation
methods and can regard failures considering load and material resistance. Furthermore they can describe and discuss the most important types of failure and damage appearance.

basic knowledge in materials science (e.g. lecture materials science I and II) recommended

regular attendance: 21 hours
self-study: 99 hours

oral exam, duration: ca. 30 minutes
no notes

Learning Content
Aim, procedure and content of examining failure

Examination methods

Types of failure:
Failure due to mechanical loads
Failure due to corrosion in electrolytes
Failure due to thermal loads
Failure due to tribological loads

Damage systematics

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature

1. G. Lange: Systematische Beurteilung technischer Schadensfälle, 6. Auflage, WILEY-VCH Verlag, 2014, ISBN 978-3-527-68316-1, In der KIT-BIB online verfügbar!
2. A. Neidel, et al.: Handbuch Metallschäden -- REM-Atlas und Fallbeispiele zur Ursachenanalyse und Vermeidung, 2. Auflage, Hanser Verlag, 2011, ISBN 978-3-446-42966-6
3. J. Grosch, et al.: Schadenskunde im Maschinenbau: Charakteristische Schadensursachen – Analyse und Aussagen von Schadensfällen, 6. Auflage, Expert-Verlag, 2014, ISBN 978-3-816-93172-0
4. E. Wendler-Kalsch, H. Gräfen: Korrosionsschadenkunde, Springer-Verlag, 1998, ISBN 3-540-63377-4

T 3.101 Course: Failure of Structural Materials: Deformation and Fracture [T-MACH-102140]

Responsible: Prof. Dr. Peter Gumbsch
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181711	Failure of structural materials: deformation and fracture	3 SWS	Lecture / Practice (VÜ)	Gumbsch, Weygand

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

Below you will find excerpts from events related to this course:

V Failure of structural materials: deformation and fracture

Lecture / Practice (VÜ)

2181711, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes

1. Introduction
2. linear elasticity
3. classification of stresses
4. Failure due to plasticity
    - tensile test
    - dislocations
    - hardening mechanisms
    - guidelines for dimensioning
5. composite materials
6. fracture mechanics
    - hypotheses for failure
    - linear elasic fracture mechanics
    - crack resitance
    - experimental measurement of fracture toughness
    - defect measurement
    - crack propagation
    - application of fracture mechanics
    - atomistics of fracture

The student

- has the basic understanding of mechanical processes to explain the relationship between externally applied load and materials strength.
- can explain the foundation of linear elastic fracture mechanics and is able to determine if this concept can be applied to a failure by fracture.
- can decribe the main empirical materials models for deformation and fracture and can apply them.
- has the physical understanding to describe and explain phenomena of failure.

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

The assessment consists of an oral examination (ca. 30 min) according to Section 4(2), 2 of the examination regulation.

Learning Content

1. Introduction
2. linear elasticity
3. classification of stresses
4. Failure due to plasticity
    - tensile test
    - dislocations
    - hardening mechanisms
    - guidelines for dimensioning
5. composite materials
6. fracture mechanics
    - hypotheses for failure
    - linear elasic fracture mechanics
    - crack resitance
    - experimental measurement of fracture toughness
    - defect measurement
    - crack propagation
    - application of fracture mechanics
    - atomistics of fracture

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

- Engineering Materials, M. Ashby and D.R. Jones (2nd Edition, Butterworth-Heinemann, Oxford, 1998); worth reading, relatively simple but comprehensive
- Mechanical Behavior of Materials, Thomas H. Courtney (2nd Edition, McGraw Hill, Singapur); classic on the mechanical behavior of materials, extensive and good
- Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relatively simple but yet comprehensive overview of metallic materials

T 3.102 Course: Failure of Structural Materials: Fatigue and Creep [T-MACH-102139]

Responsible: Dr. Patric Gruber
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181715	Failure of Structural Materials: Fatigue and Creep	2 SWS	Lecture (V)	Gruber, Gumbsch
Exams					
SS 2019	76-T-MACH-102139	Failure of Structural Materials: Fatigue and Creep		Prüfung (PR)	Gruber, Kraft, Gumbsch

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

Below you will find excerpts from events related to this course:

V Failure of Structural Materials: Fatigue and Creep
2181715, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
1 Fatigue
1.1 Introduction
1.2 Statistical Aspects
1.3 Lifetime
1.4 Fatigue Mechanisms
1.5 Material Selection
1.6 Thermomechanical Loading
1.7 Notches and Shape Optimization
1.8 Case Study: ICE-Desaster

2 Creep
2.1 Introduction
2.2 High Temperature Plasticity
2.3 Phänomenological DEsciption of Creep
2.4 Creep Mechanisms
2.5 Alloying Effects

The student

- has the basic understanding of mechanical processes to explain the relationships between externally applied load and materials strength.
- can describe the main empirical materials models for fatigue and creep and can apply them.
- has the physical understanding to describe and explain phenomena of failure.
- can use statistical approaches for reliability predictions.
- can use its acquired skills, to select and develop materials for specific applications.

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

The assessment consists of an oral examination (ca. 30 min) according to Section 4(2), 2 of the examination regulation.

Learning Content
1 Fatigue
1.1 Introduction
1.2 Statistical Aspects
1.3 Lifetime
1.4 Fatigue Mechanisms
1.5 Material Selection
1.6 Thermomechanical Loading
1.7 Notches and Shape Optimization
1.8 Case Study: ICE-Desaster

2 Creep
2.1 Introduction
2.2 High Temperature Plasticity
2.3 Phänomenological DEsciption of Creep
2.4 Creep Mechanisms
2.5 Alloying Effects

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

- Engineering Materials, M. Ashby and D.R. Jones (2nd Edition, Butterworth-Heinemann, Oxford, 1998); worth reading, relatively simple but comprehensive
- Mechanical Behavior of Materials, Thomas H. Courtney (2nd Edition, McGraw Hill, Singapur); classic on the mechanical behavior of materials, extensive and good
- Bruchvorgänge in metallischen Werkstoffen, D. Aurich (Werkstofftechnische Verlagsgesellschaft Karlsruhe), relatively simple but yet comprehensive overview of metallic materials
- Fatigue of Materials, Subra Suresh (2nd Edition, Cambridge University Press); standard work on fatigue, all classes of materials, extensive, for beginners and advanced student

T 3.103 Course: Fatigue of Metallic Materials [T-MACH-105354]

Responsible: Dr.-Ing. Stefan Guth
Dr. Karl-Heinz Lang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2173585	Fatigue of Metallic Materials	2 SWS	Lecture (V)	Guth, Lang
Exams					
SS 2019	76-T-MACH-105354	Fatigue of Metallic Materials		Prüfung (PR)	Lang, Guth
WS 19/20	76-T-MACH-105354	Fatigue of Metallic Materials		Prüfung (PR)	Lang, Guth

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basic knowledge in Materials Science will be helpful.

Below you will find excerpts from events related to this course:

V Fatigue of Metallic Materials
Lecture (V)

2173585, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Introduction: some interesting cases of damage

Cyclic Stress Strain Behaviour

Crack Initiation

Crack Propagation

Lifetime Behaviour under Cyclic Loading

Fatigue of Notched Components

Influence of Residual Stresses

Structural Durability

learning objectives:

The students are able to recognise the deformation and the failure behaviour of metallic materials under cyclic loading and to assign it to the basic microstructural processes. They know the sequence and the development of fatigue damages and can evaluate the initiation and the growth of fatigue cracks.

The students can assess the cyclic strength behaviour of metallic materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings. Furthermore, they can take into account the influence of residual stresses.

requirements:

none, basic knowledge in Material Science will be helpful

workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Introduction: some interesting cases of damage

Cyclic Stress Strain Behaviour

Crack Initiation

Crack Propagation

Lifetime Behaviour under Cyclic Loading

Fatigue of Notched Components

Influence of Residual Stresses

Structural Durability

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Lecture notes that include a list of current literature will be distributed.

T 3.104 Course: Fatigue of Welded Components and Structures [T-MACH-105984]

Responsible: Dr. Majid Farajian
Prof. Dr. Peter Gumbsch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	3	Each winter term	1

Events					
WS 19/20	2181731	Fatigue of Welded Components and Structures	2 SWS	Block (B)	Farajian, Gumbsch

Competence Certificate
oral examination (ca. 30 min)

no tools or reference materials

Prerequisites
admission to the exam only with successful completion of the exercises [T-MACH-109304]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-109304 - Excercises - Fatigue of Welded Components and Structures must have been passed.

Recommendation
preliminary knowlegde materials science and mechanics

Below you will find excerpts from events related to this course:

V Fatigue of Welded Components and Structures

2181731, WS 19/20, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

The student can

- describe the influence of welding induced notches, defects and residual stresses on component behavior
- explain the basics of numerical and experimental methods for the evaluation of statically or cyclically loaded welds explain and can apply them
- derive measures in order to increase the lifetime of structures with welded joints under cyclical load

preliminary knowlegde materials science and mechanics recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

Exercise sheets are handed out regularly.

oral examination (ca. 30 min)

no tools or reference materials

Learning Content
The lecture gives an introduction to the following topics:

- weld quality
- typical damages of welded joints
- evaluation of notches, defects and residual stresses
- strength concepts: nominal, structural and notch stress concepts, fracture mechanics
- life cycle analysis
- post-treatment methods for an extented lifetime
- maintenance, reconditioning and repair

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

1. D. Radaj, C.M. Sonsino and W. Fricke, Fatigue assessment of welded joints by local approaches, Second edition.Woodhead Publishing, Cambridge 2006.
2. FKM-Richtlinie, Bruchmechanischer Festigkeitsnachweis, Forschungskuratorium Maschinenbau, VDMA Verlag, 2009

T 3.105 Course: FEM Workshop - Constitutive Laws [T-MACH-105392]

Responsible: Dr. Katrin Schulz
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2183716	FEM Workshop -- Constitutive Laws	2 SWS	Block (B)	Schulz, Weygand

Competence Certificate

solving of a FEM problem

preparation of a report

preparation of a short presentation

Prerequisites

none

Recommendation

Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials

Below you will find excerpts from events related to this course:

V FEM Workshop -- Constitutive Laws

2183716, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Notes

The course repeats the fundamentals of the theory of materials. It leads to the characterization and classification of material behavior as well as the specification by adequate material models. Here we focus on elastic, viscoelastic, plastic, and viscoplastic deformation behavior. Introducing the finite element program ABAQUS, the students learn how to analyze the material models numerically. Therefore ABAQUS-own and continuative constitutive equations are chosen.

The student

- has the basic understanding of the materials theory and the classification of materials
- is able to independently generate numerical models using ABAQUS and can choose and apply adequate constitutive equations

Engineering Mechanics; Advanced Mathematics; Introduction to Theory of Materials recommended

regular attendance: 28 hours
self-study: 92 hours

Oral examination in the elective module MSc, otherwise no grading

solving of a FEM problem

preparation of a report

preparation of a short presentation

T 3.106 Course: Financial Analysis [T-WIWI-102900]

Responsible: Dr. Torsten Luedecke
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	4,5	Each summer term	1

Events					
SS 2019	2530205	Financial Analysis	2 SWS	Lecture (V)	Luedecke
SS 2019	2530206	Übungen zu Financial Analysis	2 SWS	Practice (Ü)	Luedecke
Exams					
SS 2019	7900075	Financial Analysis		Prüfung (PR)	Luedecke

Competence Certificate
See German version.

Prerequisites
None

Recommendation
Basic knowledge in corporate finance, accounting, and valuation is required.

Below you will find excerpts from events related to this course:

V Financial Analysis
2530205, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
This lecture reviews the key financial statements according to international financial reporting standards and provides analytical tools to evaluate the income statement, the balance sheet, and the cash flow statement in order to measure a firm's liquidity, operational efficiency, and profitability.

Learning Content
Topics:

- Introduction to Financial Analysis
- Financial Reporting Standards
- Major Financial Statements and Other Information
- Recognition and Measurement Issues
- Analysis of Financial Statements
- Financial Reporting Quality

Literature

- Alexander, D. and C. Nobes (2017): Financial Accounting – An International Introduction, 6th ed., Pearson.
- Penman, S.H. (2013): Financial Statement Analysis and Security Valuation, 5th ed., McGraw Hill.

T 3.107 Course: Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems [T-MACH-105391]

Responsible: Prof. Dr. Claus Günther
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153405	Finite Difference Methods for numerial solution of thermal and fluid dynamical problems	2 SWS	Lecture (V)	Günther
Exams					
SS 2019	76-T-MACH-105391	Finite Difference Methods for Numerial Solution of Thermal and Fluid Dynamical Problems		Prüfung (PR)	Günther

Competence Certificate
oral exam, Duration: 30 minutes

no auxiliary means

Prerequisites
none

Below you will find excerpts from events related to this course:

V Finite Difference Methods for numerial solution of thermal and fluid dynamical problems

Lecture (V)

2153405, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
This lecture will be omitted until further.

The students can apply the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. They are able to discuss the most relevant properties of difference schemes such as consistency, stability and convergence. Furthermore, they can estimate the order of the numerical error and non-appearance of numerical oscillations.

The students get a basic knowledge of relevant numerical algorithms and the use of them in commercial and open fluid flow codes.

The lecture initially presents an overview and then the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. The most relevant properties of difference schemes at one side as consistency, stability and convergence, at the other side the order of the numerical error and non-appearance of numerical oscillations are described. Algorithms for the solution of coupled systems of equations, characteristic for fluid flow and thermal problems, are reviewed.

- Spatial and temporal discretization
- Properties of difference schemes
- Numerical stability, consistency, convergence
- Nonhomogeneous meshes
- Coupled and noninteracting calculation methods

Learning Content

The lecture initially presents an overview and then the most important difference schemes for the numerical solution of steady and transient problems which are typical for thermal and fluid flow problems. The most relevant properties of difference schemes at one side as consistency, stability and convergence, at the other side the order of the numerical error and non-appearance of numerical oscillations are described. Algorithms for the solution of coupled systems of equations, characteristic for fluid flow and thermal problems, are reviewed.

- Spatial and temporal discretization
- Properties of difference schemes
- Numerical stability, consistency, convergence
- Nonhomogeneous meshes
- Coupled and noninteracting calculation methods

Workload

regulare attendance: 21h

self-study: 100h

T 3.108 Course: Finite Element Workshop [T-MACH-105417]

Responsible: Prof. Dr. Claus Mattheck
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2182731	Finite Element Workshop	2 SWS	Block (B)	Weygand, Mattheck, Tesari

Competence Certificate
attendance certificate for participation in all course dates

Prerequisites
none

Recommendation
Continuum Mechanics

Below you will find excerpts from events related to this course:

V Finite Element Workshop

2182731, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Notes
The students will learn the foundations of the FEM stress analysis and the optimization methode 'Zugdreiecke'.

The student can

- perform stress analysis for simple components using the commercial software package ANSYS
- utilise the method of the tensile triangle to optimize the shape of components with respect to stress distribution

Fundamentals of Continuum Mechanics are required.

regular attendance: 22,5 hours

certificate in case of regular attendance

Learning Content
The students will learn the foundations of the FEM stress analysis and the optimization methode 'Zugdreiecke'.

Workload
regular attendance: 22,5 hours

T 3.109 Course: Flow Simulations [T-MACH-105458]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2154447	Flow Simulations	2 SWS	Practical course (P)	Bruzzese, Frohnapfel, Mitarbeiter

Competence Certificate
ungraded homework and colloquium

Prerequisites
none

Below you will find excerpts from events related to this course:

V Flow Simulations

2154447, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Description
Practical exercises

Notes
Flow Simulations with OpenFOAM(R)

- Basic elements of a simulation with OPENFOAM(R)
- Simulation of 'classic' incompressible, stationary/unstationary, laminar/turbulent (in RANS context) flows (special types of flows, e.g. reactive flows, multi-phase flows, magnetohydrodynamics, ... are not covered)
- Visualization of results
- Evaluation and interpretation of results
- Necessary basics of turbulence modelling with RANS models in OPENFOAM(R)
- Basics of the structure and the numerics of OPENFOAM(R) and possibilities for extending the software

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Learning Content
Flow Simulations with OpenFOAM(R)

- Basic elements of a simulation with OPENFOAM(R)
- Simulation of 'classic' incompressible, stationary/unstationary, laminar/turbulent (in RANS context) flows (special types of flows, e.g. reactive flows, multi-phase flows, magnetohydrodynamics, ... are not covered)
- Visualization of results
- Evaluation and interpretation of results
- Necessary basics of turbulence modelling with RANS models in OPENFOAM(R)
- Basics of the structure and the numerics of OPENFOAM(R) and possibilities for extending the software

Students are able to use the basic functionality of the open source software OPENFOAM(R) for simulating laminar and turbulent flows (in RANS context). They know the setup and the process of a fluid mechanical simulation with OPENFOAM(R). The students are able to visualize the results and to question the plausibility of the results. They are able to build simple block-structured meshes and meshes of more complex three-dimensional domains. The students are aware of the sensitivity of the results of a flow simulation (meshing, numerical settings, turbulence model).

Annotation

Block course with limited number of participants, registration in the secretary's office required. See details at **www.istm.kit.edu**

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Workload

regulare attendance: 30h

self-study: 90h

Literature

H. Ferziger, M. Peric, *Computational Methods for Fluid Dynamics*, Springer, 2008

T 3.110 Course: Flows and Heat Transfer in Energy Technology [T-MACH-105403]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189911	Tutorial 'Flows and Heat Transfer in Energy Technology '	1 SWS	Practice (Ü)	Cheng, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105403	Flows and Heat Transfer in Energy Technology		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 20 min

Prerequisites
none

T 3.111 Course: Flows with Chemical Reactions [T-MACH-105422]

Responsible: Prof. Dr. Andreas Class
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153406	Flows with chemical reactions	2 SWS	Lecture (V)	Class

Competence Certificate
oral exam, duration 30 minutes

Auxiliary none

Prerequisites
none

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

Below you will find excerpts from events related to this course:

V Flows with chemical reactions
2153406, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Black board

Notes
The students can describe flow scenarios, where a chemical reaktion is confined to a thin layer. They can choose simplifying approaches for the underlying chemistry and discuss the problems with focus on the fluid mechanic aspects. The students are able to solve simple problems analytically. Furthermore, they are qualified to discuss simplifications as relevant for an efficent numerical solution of complex problems.

In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

Learning Content
In the lecture we mainly consider problems, where chemical reaktion is confined to a thin layer.
The problems are solved analytically or they are at least simplified allowing for efficent numerical
sollution procedures. We apply simplified chemistry and focus on the fluid mechanic aspects of the problems.

Workload
regulare attendance: 22.5h

self-study: 99h

Literature
Lecture

Buckmaster, J.D.; Ludford, G.S.S.: Lectures on Mathematical Combustion, SIAM 1983

T 3.112 Course: Fluid Power Systems [T-MACH-102093]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Felix Pult

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2114093	Fluid Technology	2 SWS	Lecture (V)	Geimer, Pult
Exams					
SS 2019	76-T-MACH-102093	Fluid Power Systems		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-102093	Fluid Power Systems		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of a writen exam (90 minutes) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fluid Technology

2114093, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
In the range of hydrostatics the following topics will be introduced:

- Hydraulic fluids
- Pumps and motors
- Valves
- Accessories
- Hydraulic circuits.

In the range of pneumatics the following topics will be introduced:

- Compressors
- Motors
- Valves
- Pneumatic circuits.

Workload

- regular attendance: 21 hours
- self-study: 92 hours

Literature
Scritum for the lecture *Fluidtechnik*

Institute of Vehicle System Technology

downloadable

T 3.113 Course: Fluid-Structure-Interaction [T-MACH-105474]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Dr.-Ing. Mark-Patrick Mühlhausen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154401	Fluid-Structure-Interaction	2 SWS		Mühlhausen
Exams					
SS 2019	76-T-MACH-105474	Fluid-Structure-Interaction		Prüfung (PR)	Mühlhausen

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fluid-Structure-Interaction
2154401, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture first introduces/recalls the fundamental governing equations that describe fluids and structures. After the characterization of the problem, the relevant equations are discussed and geometry and grid generation are treated. The resulting partial differential equations are transformed into an algebraic set of equations using different DFG and CSD methods and discretization schemes. Different methods for fluid structure coupling are introduced, where the resulting stability problem is treated in detail. Finally, the obtained result is critically examined in terms of errors and inaccuracy and verification and validation procedures are introduced.

The lecture includes an introduction to function of CFG-Programs and Matlab routines that are related to the theoretically discussed approaches.

Annotation
Block course with limited number of participants, registration in the secretary's office required.

See details at www.istm.kit.edu

Workload
regular attendance: 21.5h

self-studie: 99h

Literature
will be introduced during the lecture

T 3.114 Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

Responsible: Prof. Dr. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181720	Foundations of nonlinear continuum mechanics	2 SWS	Lecture (V)	Kamlah
Exams					
SS 2019	76-T-MACH-105324	Foundations of Nonlinear Continuum Mechanics		Prüfung (PR)	Kamlah

Competence Certificate
oral exam

Below you will find excerpts from events related to this course:

V Foundations of nonlinear continuum mechanics — Lecture (V)
2181720, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture is organized in three parts. In the first part, the mathematical foundations of tensor algebra and tensor analysis are introduced, usually in cartesian representation. In the second part of the lecture, the kinematics, i.e. the geometry of deformation is presented. Besides finite deformation, geometric linearization is discussed. The thrid part of the lecture deals with the physical balance laws of thermomechanics. It is shown, how a special classical theory of continuum mechanics can be derived by adding a corresponding constitutive model. For the illustration of the theory, elementary examples are discussed repeatedly.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
lecture notes

T 3.115 Course: Foundry Technology [T-MACH-105157]

Responsible: Dr.-Ing. Christian Wilhelm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2174575	Foundry Technology	2 SWS	Lecture (V)	Wilhelm
Exams					
SS 2019	76-T-MACH-105157	Foundry Technology		Prüfung (PR)	Wilhelm

Competence Certificate
oral exam; about 25 minutes

Prerequisites
Materials Science I & II must be passed.

Below you will find excerpts from events related to this course:

V Foundry Technology
2174575, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Moulding and casting processes

Solidifying of melts

Castability

Fe-Alloys

Non-Fe-Alloys

Moulding and additive materials

Core production

Sand reclamation

Design in casting technology

Casting simulation

Foundry Processes

learning objectives:

The students know the specific moulding and casting techniques and are able to describe them in detail. The students know the application of moulding and casting techniques concerning castings and metals, their advantages and disadvantages in comparison, their application limits and are able to describe these in detail.

The students know the applied metals and are able to describe advantages and disadvantages as well as the specific range of use.

The students are able, to describe detailled mould and core materials, technologies, their application focus and mould-affected casting defects.

The students know the basics of casting process of any casting parts concerning the above mentioned criteria and are able to describe detailled.

requirements:

Required: Material Science and Engineering I and II

workload:

The workload for the lecture Foundry Technology is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Learning Content

Moulding and casting processes

Solidifying of melts

Castability

Fe-Alloys

Non-Fe-Alloys

Moulding and additive materials

Core production

Sand reclamation

Design in casting technology

Casting simulation

Foundry Processes

Workload

The workload for the lecture Foundry Technology is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Literature

Reference to literature, documentation and partial lecture notes given in lecture

T 3.116 Course: Fuels and Lubricants for Combustion Engines [T-MACH-105184]

Responsible: Dr.-Ing. Bernhard Ulrich Kehrwald
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2133108	Fuels and Lubricants for Combustion Engines	2 SWS	Lecture (V)	Kehrwald
Exams					
SS 2019	76-T-MACH-105184	Fuels and Lubricants for Combustion Engines		Prüfung (PR)	Kehrwald
WS 19/20	76-T-MACH-105184	Fuels and Lubricants for Combustion Engines		Prüfung (PR)	Kehrwald

Competence Certificate
oral examination, Duration: ca. 25 min., no auxiliary means

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fuels and Lubricants for Combustion Engines

Lecture (V)

2133108, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Introduction and basics

Fuels for Gasoline and Diesel engines

Hydrogen

Lubricants for Gasoline and Diesel engines

Coolants for combustion engines

Learning Content
Introduction and basics

Fuels for Gasoline and Diesel engines

Hydrogen

Lubricants for Gasoline and Diesel engines

Coolants for combustion engines

Workload
regular attendance: 24 hours
self-study: 96 hours

Literature
Lecturer notes

3.117 Course: Functional Ceramics [T-MACH-105179]

Responsible: Dr. Manuel Hinterstein
Dr.-Ing. Wolfgang Rheinheimer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2126784	Functional Ceramics	2 SWS	Lecture (V)	Hinterstein

Competence Certificate

The assessment consists of an oral exam (20 min) taking place at the agreed date.

Auxiliary means: none

The re-examination is offered upon agreement.

Prerequisites

none

T 3.118 Course: Fundamentals for Design of Motor-Vehicle Bodies I [T-MACH-102116]

Responsible: Horst Dietmar Bardehle
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Events					
WS 19/20	2113814	Fundamentals for Design of Motor-Vehicles Bodies I	1 SWS	Lecture (V)	Bardehle
Exams					
SS 2019	76-T-MACH-102116	Fundamentals for Design of Motor-Vehicle Bodies I		Prüfung (PR)	Bardehle, Unrau

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals for Design of Motor-Vehicles Bodies I

2113814, WS 19/20, 1 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Anticipated dates: 23 October 2019, 30 October 2019, 6 November 2019, 20 November 2019, 27 November 2019 (alternate date), and 4 December 2019 (alternate date).
Further information will be published on the homepage of the institute

Learning Content
1. History and design

2. Aerodynamics

3. Design methods (CAD/CAM, FEM)

4. Manufacturing methods of body parts

5. Fastening technologie

6. Body in white / body production, body surface

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

T 3.119 Course: Fundamentals for Design of Motor-Vehicle Bodies II [T-MACH-102119]

Responsible: Horst Dietmar Bardehle
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2019	2114840	Fundamentals for Design of Motor-Vehicles Bodies II	1 SWS	Lecture (V)	Bardehle
Exams					
SS 2019	76-T-MACH-102119	Fundamentals for Design of Motor-Vehicle Bodies II		Prüfung (PR)	Bardehle, Gauterin

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals for Design of Motor-Vehicles Bodies II — Lecture (V)
2114840, SS 2019, 1 SWS, Language: German, Open in study portal

Notes
Scheduled dates:
see homepage of the institute.
Further information and possible changes of date: see homepage of the institute.

Learning Content
1. Body properties/testing procedures

2. External body-parts

3. Interior trim

4. Compartment air conditioning

5. Electric and electronic features

6. Crash tests

7. Project management aspects, future prospects

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Automobiltechnische Zeitschrift ATZ, Friedr. Vieweg & Sohn Verlagsges. mbH, Wiesbaden
2. Automobil Revue, Bern (Schweiz)
3. Automobil Produktion, Verlag Moderne Industrie, Landsberg

T 3.120 Course: Fundamentals in the Development of Commercial Vehicles I [T-MACH-105160]

Responsible: Prof. Dr. Jörg Zürn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	1

Events					
WS 19/20	2113812	Fundamentals in the Development of Commercial Vehicles I	1 SWS	Lecture (V)	Zürn
Exams					
SS 2019	76-T-MACH-105160	Fundamentals in the Development of Commercial Vehicles I		Prüfung (PR)	Zürn

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals in the Development of Commercial Vehicles I

2113812, WS 19/20, 1 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Anticipated dates: 12 November 2019, 19 November 2019, 26 November 2019, and 10 December 2019.
Further information will be published on the homepage of the institute.

Learning Content
1. Introduction, definitions, history
2. Development tools
3. Complete vehicle
4. Cab, bodyshell work
5. Cab, interior fitting
6. Alternative drive systems
7. Drive train
8. Drive system diesel engine
9. Intercooled diesel engines

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Marwitz, H., Zittel, S.: ACTROS -- die neue schwere Lastwagenbaureihe von Mercedes-Benz, ATZ 98, 1996, Nr. 9

2. Alber, P., McKellip, S.: ACTROS -- Optimierte passive Sicherheit, ATZ 98, 1996

3. Morschheuser, K.: Airbag im Rahmenfahrzeug, ATZ 97, 1995, S. 450 ff.

3.121 Course: Fundamentals in the Development of Commercial Vehicles II [T-MACH-105161]

Responsible: Prof. Dr. Jörg Zürn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2019	2114844	Fundamentals in the Development of Commercial Vehicles II	1 SWS	Lecture (V)	Zürn
Exams					
SS 2019	76-T-MACH-105161	Fundamentals in the Development of Commercial Vehicles II		Prüfung (PR)	Zürn

Competence Certificate
Oral group examination

Duration: 30 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

Fundamentals in the Development of Commercial Vehicles II
Lecture (V)
2114844, SS 2019, 1 SWS, Language: German, Open in study portal

Learning Content
1. Gear boxes of commercial vehicles
2. Intermediate elements of the drive train
3. Axle systems
4. Front axles and driving dynamics
5. Chassis and axle suspension
6. Braking System
7. Systems
8. Excursion

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

1. Schittler, M., Heinrich, R., Kerschbaum, W.: Mercedes-Benz Baureihe 500 -- neue V-Motorengeneration für schwere Nutzfahrzeuge, MTZ 57 Nr. 9, S. 460 ff., 1996

2. Robert Bosch GmbH (Hrsg.): Bremsanlagen für Kraftfahrzeuge, VDI-Verlag, Düsseldorf, 1. Auflage, 1994

3. Rubi, V., Strifler, P. (Hrsg. Institut für Kraftfahrwesen RWTH Aachen): Industrielle Nutzfahrzeugentwicklung, Schriftenreihe Automobiltechnik, 1993

T 3.122 Course: Fundamentals of Automobile Development I [T-MACH-105162]

Responsible: Dipl.-Ing. Rolf Frech
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	2	Each winter term	1

Events					
WS 19/20	2113810	Fundamentals of Automobile Development I	1 SWS	Lecture (V)	Frech
WS 19/20	2113851	Principles of Whole Vehicle Engineering I	1 SWS	Lecture (V)	Frech
Exams					
SS 2019	76-T-MACH-105162	Fundamentals of Automobile Development I		Prüfung (PR)	Frech, Unrau

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals of Automobile Development I — Lecture (V)
2113810, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes
Block lecture in room 219 in building 70.04 (Campus East).
Date: 21 October 2019, 28 October 2019 and 18 November 2019 from 8:00 to 11:00 a.m.
Further information will be published on the homepage of the institute.

Learning Content
1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons

V **Principles of Whole Vehicle Engineering I** **Lecture (V)**

2113851, WS 19/20, 1 SWS, Language: English, Open in study portal

Notes

Block lecture in room 219 in building 70.04 (Campus East), in English.
Date: 21 October 2019, 28 October 2019 and 18 November 2019 from 11:00 a.m. to 2:00 p.m.
Further information will be published on the homepage of the institute.

Learning Content

1. Process of automobile development
2. Conceptual dimensioning and design of an automobile
3. Laws and regulations – National and international boundary conditions
4. Aero dynamical dimensioning and design of an automobile I
5. Aero dynamical dimensioning and design of an automobile II
6. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines I
7. Thermo-management in the conflict of objectives between styling, aerodynamic and packaging guidelines II

Workload

regular attendance: 10,5 hours
self-study: 49,5 hours

Literature

The scriptum will be provided during the first lessons

T 3.123 Course: Fundamentals of Automobile Development II [T-MACH-105163]

Responsible: Dipl.-Ing. Rolf Frech
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	2	Each summer term	2

Events					
SS 2019	2114842	Fundamentals of Automobile Development II	1 SWS	Lecture (V)	Frech
SS 2019	2114860	Principles of Whole Vehicle Engineering II	1 SWS		Frech
Exams					
SS 2019	76-T-MACH-105163	Fundamentals of Automobile Development II		Prüfung (PR)	Frech, Unrau

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals of Automobile Development II
2114842, SS 2019, 1 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons.

V Principles of Whole Vehicle Engineering II
2114860, SS 2019, 1 SWS, Language: English, Open in study portal

Notes
In English language.

Learning Content
1. Application-oriented material and production technology I
2. Application-oriented material and production technology II
3. Overall vehicle acoustics in the automobile development
4. Drive train acoustics in the automobile development
5. Testing of the complete vehicle
6. Properties of the complete automobile

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
The scriptum will be provided during the first lessons.

T 3.124 Course: Fundamentals of Catalytic Exhaust Gas Aftertreatment [T-MACH-105044]

Responsible: Prof. Dr. Olaf Deutschmann
Prof. Dr. Jan-Dierk Grunwaldt
Dr.-Ing. Heiko Kubach
Prof. Dr.-Ing. Egbert Lox

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2134138	Fundamentals of catalytic exhaust gas aftertreatment	2 SWS	Lecture (V)	Lox, Grunwaldt, Deutschmann
Exams					
SS 2019	76-T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment		Prüfung (PR)	Lox
WS 19/20	76-T-MACH-105044	Fundamentals of Catalytic Exhaust Gas Aftertreatment		Prüfung (PR)	Lox

Competence Certificate
oral examination, Duration: 25 min., no auxiliary means

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals of catalytic exhaust gas aftertreatment — Lecture (V)
2134138, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
1. kind and source of emissions
2. emission legislation
3. principal of catalytic exhaust gas aftertreatment (EGA)
4. EGA at stoichiometric gasoline engines
5. EGA at gasoline engines with lean mixtures
6. EGA at diesel engines
7. economical basic conditions for catalytic EGA

Workload
regular attendance: 36 hours
self-study: 84 hours

Literature

Lecture notes available in the lectures

1. ''Environmental Catalysis'' Edited by G.Ertl, H. Knötzinger, J. Weitkamp Wiley-VCH Verlag GmbH, Weinheim, 1999 ISBN 3-527-29827-4
2. ''Cleaner Cars- the history and technology of emission control since the 1960s'' J. R. Mondt Society of Automotive Engineers, Inc., USA, 2000 Publication R-226, ISBN 0-7680-0222-2
3. ''Catalytic Air Pollution Control - commercial technology'' R. M. Heck, R. J. Farrauto John Wiley & Sons, Inc., USA, 1995 ISBN 0-471-28614-1
4. ''Automobiles and Pollution'' P. Degobert Editions Technic, Paris, 1995 ISBN 2-7108-0676-2
5. ''Reduced Emissions and Fuel Consumption in Automobile Engines'' F. Schaeder, R. van Basshuysen, Springer Verlag Wien New York, 1995 ISBN 3-211-82718-8
6. ''Autoabgaskatalysatoren : Grudlagen - Herstellung - Entwicklung - Recycling - Ökologie'' Ch. Hagelüken und 11 Mitautoren, Expert Verlag, Renningen, 2001 ISBN 3-8169-1932-4

T 3.125 Course: Fundamentals of Combustion Engine Technology [T-MACH-105652]

Responsible: Dr.-Ing. Sören Bernhardt
Dr.-Ing. Heiko Kubach
Jürgen Pfeil
Dr.-Ing. Olaf Toedter
Dr.-Ing. Uwe Wagner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	1

Events					
WS 19/20	2133123	Fundamentals of Combustion Engine Technology	2 SWS	Lecture (V)	Kubach, Wagner, Toedter, Pfeil, Bernhardt, Velji
Exams					
SS 2019	76-T-MACH-105652	Fundamentals of Combustion Engine Technology		Prüfung (PR)	Kubach
WS 19/20	76-T-MACH-105652	Fundamentals of Combustion Engine Technology		Prüfung (PR)	Kubach

Competence Certificate
oral exam, 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals of Combustion Engine Technology

Lecture (V)

2133123, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Fundamentals of engine processes

Components of combustion engines

Mixture formation systems

Gasexchange systems

Injection systems

Exhaust Gas Aftertreatment Systems

Cooling systems

Ignistion Systems

Learning Content

Fundamentals of engine processes

Components of combustion engines

Mixture formation systems

Gasexchange systems

Injection systems

Exhaust Gas Aftertreatment Systems

Cooling systems

Ignistion Systems

Workload

regular attendance 25 h

self-study 125 h

T 3.126 Course: Fundamentals of Energy Technology [T-MACH-105220]

Responsible: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering
M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	8	Each summer term	1

Events					
SS 2019	2130927	Fundamentals of Energy Technology	3 SWS	Lecture (V)	Cheng, Badea
SS 2019	3190923	Fundamentals of Energy Technology	3 SWS	Lecture (V)	Badea
Exams					
SS 2019	76-MACH-105220 Fundamentals of Energy Technology	Fundamentals of Energy Technology		Prüfung (PR)	Badea
SS 2019	76-T-MACH-105220	Fundamentals of Energy Technology		Prüfung (PR)	Cheng, Badea
WS 19/20	76-MACH-105220 Fundamentals of Energy Technology	Fundamentals of Energy Technology		Prüfung (PR)	Badea
WS 19/20	76-T-MACH-105220	Fundamentals of Energy Technology		Prüfung (PR)	Badea, Cheng

Competence Certificate
Written examination, 90 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals of Energy Technology

Lecture (V)

2130927, SS 2019, 3 SWS, Language: German, Open in study portal

Learning Content
The following relevant fields of the energy industry are covered:
- Energy demand and energy situation
- Energy types and energy mix
- Basics. Thermodynamics relevant to the energy sector
- Conventional fossil-fired power plants
- Combined Cycle Power Plants
- Cogeneration
- Nuclear energy
- Regenerative energies: hydropower, wind energy, solar energy, other energy systems
- Energy demand structures. Basics of economic efficiency and calculus. Optimization
- Energy storage
- Transport of energy
- Power generation and environment. Future of the energy industry

Workload
lectures: 45 h

preparation to exam: 195 h

V	**Fundamentals of Energy Technology** 3190923, SS 2019, 3 SWS, Language: English, Open in study portal	**Lecture (V)**

Learning Content
The following relevant fields of the energy industry are covered:
- Energy forms
- Thermodynamics relevant to energy industry
- Energy sources: fossil fuels, nuclear energy, renewable sources
- Energy industry in Germany, Europe and worldwide
- Power generation and environment
- Evaluation of energy conversion processes
- Thermal/electrical power plants and processes
- Transport of energy / energy carriers
- Energy storage
- Systems utilizing renewable energy sources
- Basics of economic efficiency and calculus / Optimisation
- Future of the energy industry

Workload
lectures: 45 h

preparation to exam: 195 h

T 3.127 Course: Fundamentals of reactor safety for the operation and dismantling of nuclear power plants [T-MACH-105530]

Responsible: Dr. Victor Hugo Sanchez-Espinoza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2190465	Fundamentals of reactor safety for the operation and dismantling of nuclear power plants	2 SWS		Sanchez-Espinoza

Competence Certificate
oral exam about 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Fundamentals of reactor safety for the operation and dismantling of nuclear power plants

2190465, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes
This lecture describes the fundamentals of reactor safety for both the operation and the decommissioning of nuclear power plants. The first part will be focused on reactor safety issues important for the operation of a NPP:

- Safety fundamentals as defense in depth, multi-barrier concepts
- Operational modes of nuclear power plants
- Main components for heat removal, safety systems of selected NPP designs
- Thermal characterization of the core and plant under normal operation conditions
- Accident analysis in nuclear power plants- initiation, methods of evaluations and safety implications

The second part of this lecture will be devoted to explain the neutron physical, radiation protection and safety aspects to be considered for the safe and economical decommissioning of nuclear power plants:

- Life cycle of a nuclear power plant and main strategies and challenges in the NPP decommissioning
- Physical processes responsible for the activation of reactor components during the operation of a nuclear power plant
- Radioactive waste generation in the core, classification and radiological relevance
- Waste classification, minimization methods and intermediate and final disposal
- Risk analysis and prevention, radiation protection issues and the regulatory framework for decommissioning
- Computational methods for the estimation of nuclei inventories, activation and dose rates of reactor components

Knowledge in energy technology, nuclear power plants, reactor physics, radiation protection is welcomed

Time of attendance: 30 hours

Self-study: 90 hours

oral examination; duration: about 30 minutes

Learning Content
This lecture describes the fundamentals of reactor safety for both the operation and the decommissioning of nuclear power plants. The first part will be focused on reactor safety issues important for the operation of a NPP:

- Safety fundamentals as defense in depth, multi-barrier concepts
- Operational modes of nuclear power plants
- Main components for heat removal, safety systems of selected NPP designs
- Thermal characterization of the core and plant under normal operation conditions
- Accident analysis in nuclear power plants- initiation, methods of evaluations and safety implications

The second part of this lecture will be devoted to explain the neutron physical, radiation protection and safety aspects to be considered for the safe and economical decommissioning of nuclear power plants:

- Life cycle of a nuclear power plant and main strategies and challenges in the NPP decommissioning
- Physical processes responsible for the activation of reactor components during the operation of a nuclear power plant
- Radioactive waste generation in the core, classification and radiological relevance
- Waste classification, minimization methods and intermediate and final disposal
- Risk analysis and prevention, radiation protection issues and the regulatory framework for decommissioning
- Computational methods for the estimation of nuclei inventories, activation and dose rates of reactor components

Workload
Time of attendance: 30 hours

Self-study: 90 hours

Literature
Bibliography related to the Block Course *"Fundamentals of Reactor Safety for the Operation and Dismantling of NPPs"*

1. **M. Laraia, "Nuclear decommissioning: planning, execution and international experience", Woodhead Publishing (2012).**
2. **"Radiological Characterization of Shut Down Nuclear Reactors for Decommissioning Purposes", IAEA Technical Report Series No. 389**
3. **"Classification of radioactive waste", IAEA Safety Standards No. GSG-1.**
4. **"Innovative and Adaptive Technologies in Decommissioning of Nuclear Facilities", IAEA-TECDOC-1602.**
5. **"Planning, Management and Organizational Aspects of the Decommissioning of Nuclear Facilities", IAEA-TECDOC-1702.**
6. **"Managing Low Radioactivity Material from the Decommissioning of Nuclear Facilities", IAEA Technical Report Series No. 462.**
7. **"Safe and effective nuclear power plant life cycle management towards decommissioning", IAEA-TECDOC-1305.**
8. **"Radiological Characterisation for Decommissioning of Nuclear Installations", NEA/RWM/WPDD(2013)2.**
9. **"Proceedings of the ICOND16/International Conference on Nuclear Decommissioning", October 2014 (Aachen, Germany).**
10. **M. Cumo, "Experiences and Techniques in the Decommissioning of Old Nuclear Power Plants, Workshop on Nuclear Reaction Data and Nuclear Reactors: Physics, Design and Safety", 25 February – 28 March 2002 (Trieste, Italy).**
11. **"Safety considerations in the Transition from Operation to Decommissioning of Nuclear Facilities", IAEA Technical Report Series 36.**
12. **"State of the Art Technology for Decontamination and Dismantling of Nuclear Facilities", IAEA Technical Report Series395.**
13. **"A review of the situation of decommissioning of nuclear installations in Europe", European Commission Report EUR 17622**
14. **"Radiation Protection Ordinance", (*http://www.bfs.de*).**

T 3.128 Course: Fusion Technology A [T-MACH-105411]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169483	Fusion Technology A	2 SWS	Lecture / Practice (VÜ)	Stieglitz
WS 19/20	2169484	Exercise Fusion Technology A	2 SWS	Practice (Ü)	Stieglitz
Exams					
SS 2019	76-T-MACH-105411	Fusion Technology A		Prüfung (PR)	Stieglitz
WS 19/20	76-T-MACH-105411	Fusion Technology A		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
appreciated is knowldege in heat ans mass transfer as well as in electrical engineering,
basic knowledge in fluid mechanics, material sciences and physics

Below you will find excerpts from events related to this course:

V Fusion Technology A

2169483, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes

To transfer the basic physical concepts of particle physics, fusion and nuclear fission; this includes fundamental questions such as how: What is a plasma? How can it be ignited? What is the difference between magnetic and inertial fusion? Based on this, aspects of the stability of plasmas, their control and particle transport are discussed. After characterizing the plasma, the "fire" of fusion, the confinement in magnetic fields is sketched, which are built up with the help of magnetic technology. Here, knowledge of superconductivity, production and design of magnets is imparted. A reactor operation with a plasma as energy source requires a continuous operation of a tritium and fuel cycle, which is generated by the fusion reactor itself. Since fusion plasmas require small material densities, vacuum technology plays a central role. Finally, the heat generated in the fusion power plant must be converted into a power plant process and the reaction products removed. The functional basics and the structure of these fusion-typical in-vessel components are presented and the current challenges and the state of the art are demonstrated.

The course describes the essential functional principles of a fusion reactor, beginning with plasma, magnet technology, the tritium and fuel cycle, vacuum technology and the associated material sciences. The physical basics will be taught and the engineering laws of scaling will be demonstrated. Special importance is attached to the understanding of the interfaces between the different subject areas, which essentially determine the engineering technical interpretations. Methods for identifying and evaluating the central parameters will be demonstrated. Based on the acquired perception skills, methods for the design of solution strategies will be taught and technical solutions will be identified, their weak points discussed and evaluated.

Recommendations/Pre-knowledge:

Basic knowledge of fluid mechanics, materials engineering and physics. Knowledge of heat and mass transfer and electrical engineering is helpful.

Presence time: 21 h
Self-study: 90 h

Oral examination:
Duration: approx. 30 minutes, aids: none

Workload

regular attendance: 21 h
self-study:90 h

Literature

Within each subblock an adequate selection of literature is given. Additionally the students get the lecuture materials in printed and electronic version.

T 3.129 Course: Fusion Technology B [T-MACH-105433]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190492	Fusion Technology B	2 SWS	Lecture (V)	Stieglitz
SS 2019	2190493	Übungen zu Fusionstechnologie B	2 SWS	Practice (Ü)	Stieglitz
Exams					
SS 2019	76-T-MACH-105433	Fusion Technology B		Prüfung (PR)	Stieglitz
WS 19/20	76-T-MACH-105433	Fusion Technology B		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
attendance of fusion technology A lecture

reliable capability to use fundamental knowledge communicated in the bachelor study in physics, material sciences , electrical engineering and engineering design

Annotation
none

Below you will find excerpts from events related to this course:

V Fusion Technology B
2190492, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Fusion Technology B is a continuation of Fusion Technology A lecture and includes the following topics:

Fusion neutronics, materials science of thermally and neutronically highly loaded components, reactor scaling and safety as well as plasma heating and current drive. The section fusion neutronics develops the basics of fusion neutronics and its calculation methods, the nuclear physical design of a fusion reactor and the corresponding components (blankets, shielding, activation, tritium breeding ratio and dose rate). Since both neutron fluxes and area power density in a fusion power plant are significantly higher than those of other power plants, they require special materials. After an extension of existing material knowledge by fundamentals and methods for the calculation of radiation damage in materials, strategies for the material selection of functional and structural materials are shown and deepened by examples. The arrangement of components close to the plasma in a fusion power plant means changed requirements for system integration and energy conversion; these questions are the subject of the block reactor scaling and safety. In addition to the explanation of the safety objectives, the methods for achieving the objectives and the computational tools required to achieve them are dealt with in particular. To ignite the plasma, extreme temperatures of several million degrees are required. Special plasma heating methods are used for this purpose, such as electron cyclotron resonance heating (ECRH), ion cyclotron resonance heating (ICRH), current drive at the lower hybrid frequency and neutral particle injection. Their basic mode of action, design criteria, transmission options and performance are presented and discussed. In addition, the heating processes can also be used for plasma stabilization. Some considerations and limitations are presented.

The lecture, which runs over 2 semesters, is aimed at students of engineering sciences and physics after the bachelor. The aim is an introduction to the current research and development on fusion and its long-term goal of a promising energy source. After a short insight into fusion physics, the lecture focuses on key technologies for a future fusion reactor. The lecture will be accompanied by exercises at Campus Nord (block event, 2-3 afternoons per topic).

Recommendations/Prerequisites:

Knowledge of physics, heat and mass transfer, and design theory taught in the bachelor's degree. Attendance of the lecture Fusion technology A

Presence time: 21 h
Self-study: 49 h

Oral proof of participation in the exercises
Duration: approx. 25 minutes, aids: none

Learning Content

Die Fusionstechnologie B beinhaltet

Fusion neutronics, plasma facing components and plasma heating-and current drive methods. The section fusion neutronics scopes the fundamentals and calculation methods, which allows for a physical design of a nuclear fusion reactor and the corresponding components (such as blankets, divertors, shielding, activation and dose rate). Fusion reactors produce fuel their "self". The necessary blankets are complex structures whose foundations and concept options, design criteria and methods are discussed. Also the divertor is a plasma facing component. Its tasks, constraints, and design concepts are explained. The arrangement of the plasma facing components in a fusion power plant means changing demands on the system integration and energy conversion. To ignite the plasma extreme temperatures of several million degrees are required. For this purpose, special plasma heating techniques are used such as electron cyclotron resonance heating (ECRH), ion-cyclotron resonance heating (ICRH), the current drive at the lower hybrid frequency, and the neutral particle injection. Their basic mode of action, the design criteria, the transmission options and performance are presented and discussed. Additionally the heating method used also for plasma stabilization. Here are some considerations and limitations are presented.

Workload

regular attendance: 21 h
self-study: 49 h

Literature

Lecture notes

McCracken, Peter Scott, Fusion, The Energy of Universe, Elsevier Academic Press, ISBN: 0-12-481851-X

T 3.130 Course: Gasdynamics [T-MACH-105533]

Responsible: Dr.-Ing. Franco Magagnato
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2154200	Gasdynamics	2 SWS	Lecture (V)	Magagnato
Exams					
SS 2019	76-T-MACH-105533	Gasdynamics		Prüfung (PR)	Magagnato
WS 19/20	76-T-MACH-105533	Gasdynamics		Prüfung (PR)	Magagnato

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Gasdynamics
2154200, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Description
Powerpoint presentation

Notes
The student can describe the governing equations of Gas Dynamics and the associated basics in Thermodynamics. He will know different flow phenomena of applied Gas Dynamics. He can calculate compressible flows analytically. He is familiar with the Rankine-Hugoniot curve. They can derive the continuity-, the momentum- and the energy equations in differential form. With the help of the stationary flow filament theory they can calculate the normal shock wave and the associated increase of the entropy along past the shock wave. They are able to calculate the stagnation values of the Gas Dynamical variables and to determine their critical values. The students can apply the flow filament theory for variable cross-sectional areas and can distinguish between the different flow fields inside the Laval nozzle that forms with different boundary conditions. He can calculate the values behind an oblique shock wave and can distinguish between detached and attached shock waves. The student can calculate the Prandtl-Meyer expansion wave.

This lecture covers the following topics:

- Introduction to gas dynamics
- Numerical and experimental examples
- Governing equations of gas dynamics
- The transport equations in differential and integral form
- Stationary flow filament theory with and without normal shock waves
- Discussion of the energy equation: Stagnation and critical values
- Flow filament theory at variable cross-sectional area. Flow inside a Laval nozzle
- Oblique shock waves, detached shock waves
- Prandtl-Meyer expansion wave
- Viscous flows (Fanno flow)

Learning Content

This lecture covers the following topics:

- Introduction, basics of Thermodynamics
- Governing equations of gas dynamics
- Application of the conservation equations
- The transport equations in differential form
- Stationary flow filament theory with and without shock waves
- Discussion of the energy equation: Stagnation and critical values

Flow filament theory for variable cross-sectional areas. Flow inside a Laval nozzle

Workload

regular attendance: 21 hours

self-study: 84 hours

Literature

John, J., and Keith T. Gas Dynamics. 3rd ed. Harlow: Prentice Hall, 2006

Rathakrishnan, E. *Gas Dynamics*. Prentice Hall of India Pvt. Ltd, 2006

T 3.131 Course: Gear Cutting Technology [T-MACH-102148]

Responsible: Dr. Markus Klaiber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2149655	Gear Technology	2 SWS	Lecture (V)	Klaiber
Exams					
SS 2019	76-T-MACH-102148	Gear Cutting Technology		Prüfung (PR)	Schulze

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Gear Technology
2149655, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes
Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

Learning Outcomes:

The students ...

- can describe the basic terms of gearings and are able to explain the imparted basics of the gearwheel and gearing theory.
- are able to specify the different manufacturing processes and machine technologies for producing gearings. Furthermore they are able to explain the functional principles and the dis-/advantages of these manufacturing processes.
- can apply the basics of the gearing theory and manufacturing processes on new problems.
- are able to read and interpret measuring records for gearings. are able to make an appropriate selection of a process based on a given application
- can describe the entire process chain for the production of toothed components and their respective influence on the resulting workpiece properties.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content
Based on the gearing theory, manufacturing processes and machine technologies for producing gearings, the needs of modern gear manufacturing will be discussed in the lecture. For this purpose, various processes for various gear types are taught which represent the state of the art in practice today. A classification in soft and hard machining and furthermore in cutting and non-cutting technologies will be made. For comprehensive understanding the processes, machine technologies, tools and applications of the manufacturing of gearings will be introduced and the current developments presented. For assessment and classification of the applications and the performance of the technologies, the methods of mass production and manufacturing defects will be discussed. Sample parts, reports from current developments in the field of research and an excursion to a gear manufacturing company round out the lecture.

Workload
regular attendance: 21 hours
self-study: 99 hours

T 3.132 Course: Global Logistics [T-MACH-105379]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	3118095	Global Logistics	2 SWS		Furmans, Fleischer-Dörr, Mittwollen
Exams					
SS 2019	76-T-MACH-105379	Global Logistics		Prüfung (PR)	Furmans

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Global Logistics
3118095, SS 2019, 2 SWS, Language: English, Open in study portal

Notes
The course takes place in form of a block event, i.e. all lectures will be given in one week. The dates of the lecture, i.e. the respective week, will be published on the IFL homepage.

Learning Content
Conveyor Systems

- Basic elements of conveyor systems
- Key ?gures
- Branching elements

- continuous/partially-continuous
- deterministic/stochastic switch

- Integration elements
- continuous/partially-continuous
- dispatching rules

Queueing Theory and Production Logistics

- Basic queueing systems
- Distributions
- M|M|1 and M|G|1 model
- Application on production logistics

Distribution Centers and Order Picking

- The location problem
- Distribution centers
- Inventory management
- Order picking

Vehicle Routing

- Types of vehicle routing problems
- Linear programming model and graph theoretic model
- Heuristics
- Supporting technologies

Optimization of Logistical Networks

- Objectives
- Cooperative strategies
- Supply chain management
- Implementation

Annotation
Attendance during lecture is required

Literature
Arnold, Dieter; Furmans, Kai : Material?uss in Logistiksystemen; Springer-Verlag Berlin Heidelberg,

T 3.133 Course: Global Production and Logistics - Part 2: Global Logistics [T-MACH-105159]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2149600	Global Production and Logistics - Part 2: Global Logistics	2 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-105159	Global Production and Logistics - Part 2: Global Logistics		Prüfung (PR)	Furmans

Competence Certificate
The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
none

Recommendation
We recommend attending the course "Logistics - organization, design and control of logistic systems " (2118078) beforehand.

Below you will find excerpts from events related to this course:

V Global Production and Logistics - Part 2: Global Logistics

Lecture (V)

2149600, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

presentations, black board

Notes
Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies

Inventory management considering lead time and shipping costs

After taking this course students are able to:

- assign basic problems of planning and operation of global supply chains and plan them with apropriate methods,
- describe requirements and characteristics of global trade and transport, and
- evaluate characteristics of the design from logistic chains regarding their suitability.

The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

The main exam is offered every summer semester. A second date for the exam is offered in winter semester only for students that did not pass the main exam.

Recommendations:

We recommend the course "Logistics - organisation, design and control of logistic systems " (2118078) beforehand.

regular attendance: 21 hours
self-study: 99 hours

Learning Content
Characteristics of global trade

- Incoterms
- Customs clearance, documents and export control

Global transport and shipping

- Maritime transport, esp. container handling
- Air transport

Modeling of supply chains

- SCOR model
- Value stream analysis

Location planning in cross-border-networks

- Application of the Warehouse Location Problem
- Transport Planning

Inventory Management in global supply chains

- Stock keeping policies

Inventory management considering lead time and shipping costs

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature

Elective literature:

- Arnold/Isermann/Kuhn/Tempelmeier. HandbuchLogistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
- Domschke. Logistik, Rundreisen und Touren,Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, OldenbourgVerlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Neumann-Morlock. Operations-Research,Hanser-Verlag, 1993
- Tempelmeier. Bestandsmanagement in SupplyChains, Books on Demand 2006
- Schönsleben. IntegralesLogistikmanagement, Springer, 1998

T 3.134 Course: Handling Characteristics of Motor Vehicles I [T-MACH-105152]

Responsible: Dr.-Ing. Hans-Joachim Unrau
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113807	Handling Characteristics of Motor Vehicles I	2 SWS	Lecture (V)	Unrau
Exams					
SS 2019	76-T-MACH-105152	Handling Characteristics of Motor Vehicles I		Prüfung (PR)	Unrau

Competence Certificate
Verbally

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Handling Characteristics of Motor Vehicles I
2113807, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
1. Problem definition: Control loop driver - vehicle - environment (e.g. coordinate systems, modes of motion of the car body and the wheels)

2. Simulation models: Creation from motion equations (method according to D'Alembert, method according to Lagrange, programme packages for automatically producing of simulation equations), model for handling characteristics (task, motion equations)

3. Tyre behavior: Basics, dry, wet and winter-smooth roadway

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Willumeit, H.-P.: Modelle und Modellierungsverfahren in der Fahrzeugdynamik,
B. G. Teubner Verlag, 1998

2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004

3. Gnadler, R.; Unrau, H.-J.: Reprint collection to the lecture Handling Characteristics of Motor Vehicles I

T 3.135 Course: Handling Characteristics of Motor Vehicles II [T-MACH-105153]

Responsible: Dr.-Ing. Hans-Joachim Unrau
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114838	Handling Characteristics of Motor Vehicles II	2 SWS	Lecture (V)	Unrau
Exams					
SS 2019	76-T-MACH-105153	Handling Characteristics of Motor Vehicles II		Prüfung (PR)	Unrau

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Handling Characteristics of Motor Vehicles II — Lecture (V)
2114838, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
1. Vehicle handling: Bases, steady state cornering, steering input step, single sine, double track switching, slalom, cross-wind behavior, uneven roadway

2. stability behavior: Basics, stability conditions for single vehicles and for vehicles with trailer

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Zomotor, A.: Fahrwerktechnik: Fahrverhalten, Vogel Verlag, 1991

2. Mitschke, M./Wallentowitz, H.: Dynamik von Kraftfahrzeugen, Springer-Verlag, Berlin, 2004

3. Gnadler, R. Unrau, H.-J.: Reprint collection to the lecture Handling Characteristics of Motor Vehicles II

T 3.136 Course: Hands-on BioMEMS [T-MACH-106746]

Responsible: Prof. Dr. Andreas Guber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2143874	Hands-on BioMEMS	2 SWS	Lecture (V)	Guber
WS 19/20	2143874	Hands-on BioMEMS	2 SWS	Lecture (V)	Rajabi, Guber

Competence Certificate
Oral presentation and discussion (30 Min.)

Prerequisites
none

T 3.137 Course: Heat and Mass Transfer [T-MACH-105292]

Responsible: Prof. Dr.-Ing. Henning Bockhorn
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each term	1

Events					
SS 2019	3122512	Heat and Mass Transfer	2 SWS	Lecture (V)	Bockhorn
WS 19/20	2165512	Heat and mass transfer	2 SWS	Lecture (V)	Maas
Exams					
SS 2019	76-T-MACH-105292	Heat and Mass Transfer		Prüfung (PR)	Maas

Competence Certificate
Written exam, 3 h

Prerequisites
none

Below you will find excerpts from events related to this course:

V Heat and mass transfer

2165512, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- Steady and unsteady heat transfer in homogenous materials; Plates, pipe sections and sperical shells
- Molecular diffusion in gases; analogies between heat conduction and mass diffusion
- Convective, forced heat transfer in pipes/channels and around plates and profiles.
- Convective mass transfer, heat-/mass transfer analogy
- Multi phase convective heat transfer (ceondensation, evaporation)
- Radiative heat transfer

Annotation
Compulsory elective subject: 5 LP

Workload
General attendance: 22.5 h

Self-study: 97.5 h

Literature

- Maas; Vorlesungsskript "Wärme- und Stoffübertragung"
- Baehr, H.-D., Stephan, K.: "Wärme- und Stoffübertragung" , Springer Verlag, 1993
- Incropera, F., DeWitt, F.: "Fundamentals of Heat and Mass Transfer" , John Wiley & Sons, 1996
- Bird, R., Stewart, W., Lightfoot, E.: "Transport Phenomena" , John Wiley & Sons, 1960

T 3.138 Course: Heat Transfer in Nuclear Reactors [T-MACH-105529]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189907	Flow and heat transfer in nuclear reactors	2 SWS	Lecture (V)	Cheng
Exams					
SS 2019	76-T-MACH-105529	Heat Transfer in Nuclear Reactors		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Flow and heat transfer in nuclear reactors
2189907, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes

1. Reactor types and thermal-hydraulic design criteria
2. Heat transfer processes and modeling
3. Pressure drop calculation
4. Temperature distribution in nuclear reactor
5. Numerical analysis methods for nuclear reactor thermal-hydraulics

Learning Content

1. Reactor types and thermal-hydraulic design criteria
2. Heat transfer processes and modeling
3. Pressure drop calculation
4. Temperature distribution in nuclear reactor
5. Numerical analysis methods for nuclear reactor thermal-hydraulics

Workload
Time of attendance: 21 hours
Self-study: 99 hours

Literature

1. L.S. Tong, J. Weisman, Thermal-hydraulics of pressurized water reactors, American Nuclear Society, La Grande Park, Illinois, USA
2. R.T. Lahey, F.J. Moody, The Thermal-Hydraulics of a Boiling Water Nuclear Reactor, 2nd edition, ANS, La Grande Park, Illinois, USA, 1993

T 3.139 Course: Heatpumps [T-MACH-105430]

Responsible: Prof. Dr. Ulrich Maas
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2166534	Heatpumps	2 SWS	Lecture (V)	Wirbser
Exams					
SS 2019	76-T-MACH-105430	Heatpumps		Prüfung (PR)	Maas, Wirbser

Competence Certificate
Oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Heatpumps

Lecture (V)

2166534, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The aim of this lecture is to promote heat pumps as heating systems for small an medium scale facilities and to discuss their advantages as well as their drawbacks. After considering the actual energy situation and the political requirements the different aspects of heat pumps are elucidated. The requirements concerning heat sources, the different components and the various types of heat pumps are discussed. In addition ecological and economical aspects are taken into consideration. The coupling of heat pumps with heat accumulators in heating systems will also be part of the lecture.

Workload
Regular attendance: 21 hours

Self-study: 100 hours

Literature
Vorlesungsunterlagen

Bach, K.: Wärmepumpen, Bd. 26 Kontakt und Studium, Lexika Verlag, 1979

Kirn, H., Hadenfeldt, H.: Wärmepumpen, Bd. 1: Einführung und Grundlagen, Verlag C. F. Müller, 1987

von Cube, H.L.: Lehrbuch der Kältetechnik, Verlag C.F. Müller, Karlsruhe, 1975.

von Cube, H.L., Steimle,F.: Wärmepumpen, Grunglagen und Praxis VDI-Verlag, Düsseldorf, 1978.

T 3.140 Course: High Performance Computing [T-MACH-105398]

Responsible: Prof. Dr. Britta Nestler
Dr.-Ing. Michael Selzer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	5	Each term	2

Events					
WS 19/20	2183721	High Performance Computing	2 SWS	Lecture / Practice (VÜ)	Nestler, Selzer, Hötzer

Competence Certificate
At the end of the semester, there will be a written exam (90 min).

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

regular participation in the additionally offered computer exercises

Below you will find excerpts from events related to this course:

V High Performance Computing
2183721, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

Slides of the lecture, excercise sheets, solution files of the computer excercises.

Notes
Topics of the high performance computing courde are:

- achitectures of parallel platforms
- parallel programming models
- performance analysis of concurrent programs
- parallelization models
- MPI and OpenMP
- onte-Carlo method
- 1D & 2D heat diffusion
- raycasting
- n-body problem
- simple phase-field models

The student

- can explain the foundations and strategies of parallel programming
- can efficiently apply high performance computers for simulations by elaborating respective parallelisation techniques.
- has an overview of typical applications and the specific requirements for parallelization.
- knows the concepts of parallelisation and is capable to apply these to efficiently use high performance computing resources and the growing performance of multi core processors in science and industry.
- has experiences in programming of parallel algorithms through integrated computer exercises.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly discuss excercises at the computer.

At the end of the semester, there will be a written exam.

Learning Content
Topics of the high performance computing course are:

- achitectures of parallel platforms
- parallel programming models
- key figures and performance analysis of concurrent programs
- parallelization models
- MPI and OpenMP
- parallel I/O (MPI-I/O)
- vector processing (SIMD)
- cache coherence protocols
- interconnection networks
- simple phase-field models
-

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Lecture Notes; Problem Sheets; Program templates
2. Foundations of Multithreaded, Parallel, and Distributed Programming, Gregory R. Andrews; Addison Wesley 2000

T 3.141 Course: High Performance Powder Metallurgy Materials [T-MACH-102157]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2126749	Advanced powder metals	2 SWS	Lecture (V)	Schell
Exams					
SS 2019	76-T-MACH-102157	High Performance Powder Metallurgy Materials		Prüfung (PR)	Schell
WS 19/20	76-T-MACH-102157	High Performance Powder Metallurgy Materials		Prüfung (PR)	Schell

Competence Certificate
oral exam, 20- 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Advanced powder metals

2126749, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The lecture gives an overview on production, properties and application of structural and functional powder metallurgy material. The following groups of materials are presented: PM High Speed Steels, Cemented Carbides, PM Metal Matrix Composites, PM Specialities, PM Soft Magnetic and Hard Magnetic Materials.

Workload
regular attendance: 22 hours
self-study: 98 hours

Literature

- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T 3.142 Course: High Temperature Materials [T-MACH-105459]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2174600	High Temperature Structural Materials	2 SWS	Lecture (V)	Heilmaier
Exams					
SS 2019	76-T-MACH-105459	High Temperature Materials		Prüfung (PR)	Heilmaier, Lang
WS 19/20	76-T-MACH-105459	High Temperature Materials		Prüfung (PR)	Heilmaier, Lang

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V High Temperature Structural Materials

2174600, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Phenomenology of High Temperature Deformation
- Deformation Mechanisms
- High Temperature Structural Materials

learning objectives:

Students are able to

- Define properly the term "high temperature" with respect to materials
- Describe the shape of the creep curve based on underlying deformation mechanisms
- Rationalize the influence of relevant parameters such as temperature, stress, microstructure on the high temperature deformation behavior
- Develop strategies for improving creep resistance of alloys via modifying their composition
- Select properly industrially relevant high temperature structural materials for various applications

requirements:

Relevant Bachelor degree, **Recommendations:** None

workload:

Regular attendance 28 h, self study 92 h

Learning Content

- Phenomenology of High Temperature Deformation
- Deformation Mechanisms
- High Temperature Structural Materials

Workload
Regular attendance 28 h, self study 92 h

Literature
M.E. Kassner, Fundamentals of Creep in Metals and Alloys, Elsevier, Amsterdam, 2009

T 3.143 Course: Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy [T-INFO-101262]

Responsible: Prof. Dr.-Ing. Rüdiger Dillmann
Prof. Uwe Spetzger

Organisation: KIT Department of Informatics

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	3	Each term	1

Events					
SS 2019	24678	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture (V)	Spetzger
WS 19/20	24139	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy	2 SWS	Lecture (V)	Spetzger
Exams					
SS 2019	7500145	Human Brain and Central Nervous System: Anatomy, Information Transfer, Signal Processing, Neurophysiology and Therapy		Prüfung (PR)	Dillmann

T 3.144 Course: Human Factors Engineering I [T-MACH-105518]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2109035	Human Factors Engineering I: Ergonomics	2 SWS	Lecture (V)	Deml
Exams					
SS 2019	76-T-MACH-105518	Human Factors Engineering I		Prüfung (PR)	Deml

Competence Certificate
written exam, 60 minutes

The exams are only offered in German!

Prerequisites
none

Below you will find excerpts from events related to this course:

V Human Factors Engineering I: Ergonomics
Lecture (V)

2109035, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The course "Human Factors Engineering I: Ergonomics" takes place in the first half of the semester, **until 2019/12/05**, on Wednesday and Thursday.

In the second half of the semester, **beginning with 2019/12/11**, the course "Human Factors Engineering II: Work Organisation" takes place on Wednesday and Thursday.

Content of teaching:

1. Principles of human work
2. Behavioural-science data acquisition
3. workplace design
4. work environment design
5. work management
6. labour law and advocay groups

Learning target:

The students acquire a basic knowledge in the field of ergonomics:

- They are able to consider cognitive, physiological, anthropometric, and safety technical aspects in order to design workplaces ergonomically.
- Just as well they know physical and psycho-physical fundamentals (e. g. noise, lighting, climate) in the field of work-environmental design.
- Furthermore the students are able to evaluate workplaces by knowing and being able to apply essential methods of time studies and payment systems.
- Finally, they get a first, overall insight into the German labour law as well as into the organisation of advocacy groups beyond companies.

Further on the participants get to know basic methods of behavioral-science data acquisition (e. g. eye-tracking, ECG, dual-task-paradigm).

Learning Content

1. Principles of human work
2. Behavioural-science data acquisition
3. workplace design
4. work environment design
5. work management
6. labour law and advocay groups

Workload
The amount of work accounts for 120 h (=4 ECTS).

Literature
The lecture material is available on ILIAS for download.

T 3.145 Course: Human Factors Engineering II [T-MACH-105519]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2109036	Human Factors Engineering II: Work Organisation	2 SWS	Lecture (V)	Deml
Exams					
SS 2019	76-T-MACH-105519	Human Factors Engineering II		Prüfung (PR)	Deml

Competence Certificate
written exam, 60 minutes

The exams are only offered in German!

Prerequisites
none

Below you will find excerpts from events related to this course:

V Human Factors Engineering II: Work Organisation

2109036, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content of teaching:

1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
    - personnel selection
    - personnel development
    - personnel assessment
    - work satisfaction/motivation
4. Group level
    - interaction and communication
    - management of employees
    - team work
5. Organizational level
    - structural organization
    - process organization
    - production organization

Learning target:

The students gain a first insight into empirical research methods (e. g. experimental design, statistical data evaluation). Particularly, they acquire a basic knowledge in the field of work organisation:

- *Organizational level*. Within this module the students gain also a fundamental knowledge in the field of structural, process, and production organization.
- *Group level*. Besides, they get to know basic aspects of industrial teamwork and they know relevant theories in the field of interaction and communication, the management of employees as well as work satisfaction and motivation.
- *individual level*. Finally, the students get to know also methods in the field of personnel selection, development, and assessment.

Learning Content

1. Fundamentals of work organization
2. Empirical research methods
3. Individual level
    - personnel selection
    - personnel development
    - personnel assessment
    - work satisfaction/motivation
4. Group level
    - interaction and communication
    - management of employees
    - team work
5. Organizational level
    - structural organization
    - process organization
    - production organization

Workload
The amount of work is 120 h (=4 ECTS).

Literature
The lecture material is available on ILIAS for download.

T 3.146 Course: Human Factors Engineering III: Empirical research methods [T-MACH-105830]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Examination of another type	4	Each summer term	1

Events					
SS 2019	2110036	Human Factors Engineering III: Empirical research methods	2 SWS	Lecture / Practice (VÜ)	Deml

Competence Certificate
Scientific report (about 6 pages), poster, and presentation

Prerequisites
In order to attend this lecture, it is necessary having completed "Arbeitswissenschaft I" or "Arbeitswissenschaft II" successfully.

Modeled Conditions
You have to fulfill one of 2 conditions:

1. The course T-MACH-105518 - Human Factors Engineering I must have been passed.
2. The course T-MACH-105519 - Human Factors Engineering II must have been passed.

Below you will find excerpts from events related to this course:

V Human Factors Engineering III: Empirical research methods

Lecture / Practice (VÜ)

2110036, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
The aim of the event is for the participants to know and be able to apply research methods in the field of ergonomics. The participants will get an introduction into the basics of experimental design and learn about essential methods of data collection and statistical data evaluation. Subsequently, the participants will carry out, evaluate and present their own experimental studies on topics such as "Digital Human Models", "Eyetracking" or "Driving Simulation" in the form of laboratory internships.

Translated with www.DeepL.com/Translator

T 3.147 Course: Human-Machine-Interaction [T-INFO-101266]

Responsible: Prof. Dr.-Ing. Michael Beigl
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2019	24659	Human-Computer-Interaction	2 SWS	Lecture (V)	Beigl
Exams					
SS 2019	7500048	Human-Machine-Interaction		Prüfung (PR)	Beigl
WS 19/20	7500076	Human-Machine-Interaction		Prüfung (PR)	Beigl

Prerequisites
none

T 3.148 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

Responsible: Dr.-Ing. Klaus-Peter Becker
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2306321	Hybrid and Electric Vehicles	2 SWS	Lecture (V)	Doppelbauer
WS 19/20	2306323	Tutorial for 2306323 Hybrid and Electric Vehicles	1 SWS	Practice (Ü)	Doppelbauer
Exams					
SS 2019	7306321	Hybrid and Electric Vehicles		Prüfung (PR)	Doppelbauer

Prerequisites
none

T 3.149 Course: Hydraulic Fluid Machinery [T-MACH-105326]

Responsible: Dr. Balazs Pritz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2157432	Hydraulic Fluid Machinery	4 SWS	Lecture (V)	Pritz
Exams					
SS 2019	76-T-MACH-105326	Hydraulic Fluid Machinery		Prüfung (PR)	Gabi

Competence Certificate
oral exam, 40 min.

Prerequisites
None.

Below you will find excerpts from events related to this course:

V Hydraulic Fluid Machinery
2157432, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

1. Introduction
2. Basic equations
3. System analysis
4. Elementary Theory (Euler's equation of Fluid Machinery)
5. Operation and Performance Characteristics
6. Similarities, Specific Values
7. Control technics
8. Wind Turbines, Propellers
9. Cavitation
10. Hydrodynamic transmissions and converters

Workload
regular attendance: 56 hours
self-study: 150 hours
preparation for exam: 40 hours

Literature

1. Fister, W.: Fluidenergiemaschinen I & II, Springer-Verlag
2. Bohl, W.: Strömungsmaschinen I & II . Vogel-Verlag
3. Gülich, J.F.: Kreiselpumpen, Springer-Verlag
4. Pfleiderer, C.: Die Kreiselpumpen. Springer-Verlag
5. Carolus, T.: Ventilatoren. Teubner-Verlag
6. Kreiselpumpenlexikon. KSB Aktiengesellschaft
7. Zierep, J., Bühler, K.: Grundzüge der Strömungslehre. Teubner-Verlag

T 3.150 Course: Hydrogen Technologies [T-MACH-105416]

Responsible: Dr. Thomas Jordan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170495	Hydrogen Technologies	2 SWS	Lecture (V)	Jordan
Exams					
SS 2019	76-T-MACH-105416	Hydrogen Technologies		Prüfung (PR)	Jordan

Competence Certificate
oral exam, Duration: approximately 30 minutes

Auxiliary: no tools or reference materials may be used during the exam

Prerequisites
none

Recommendation
Fundamentals Thermodynamics

Below you will find excerpts from events related to this course:

V Hydrogen Technologies

Lecture (V)

2170495, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
The course content is the cross-cutting issue of hydrogen as energy carrier. After successful participation the students may reflect on the fundamental technological basis of an energy system using predominantly hydrogen as an energy carrier or energy storage. Based on this knowledge they may objectify the principle idea of an hydrogen economy.

The students know the fundamental physical and chemical properties of hydrogen and may apply their knowledge on thermodynamics to compare efficiencies of different solutions with hydrogen. They can list, compare and evaluate established and future solutions for production, storage and distribution of hydrogen. They can explain advantages and disadvantages of using hydrogen in conventional combustion processes versus using hydrogen in different fuel cells. In particular the can describe the specific safety aspects related to hydrogen, compare them with other energy vectors and evaluate different measures for risk mitigation.

- Basic concepts
- Production
- Transport and storage
- Application
- Safety aspects

Learning Content
Basic concepts
Production
Transport and storage
Application
Safety aspects

Annotation
Recommendation: Fundamentals Thermodynamics

Workload
regular attendance: 21 h
self-study: 99 h

Literature
Ullmann's Encyclopedia of Industrial Chemistry
Hydrogen and Fuel Cells, Ed. S. Stolten, Wiley-VCH, 2010, ISBN 978-3-527-32711-9

T 3.151 Course: Industrial Aerodynamics [T-MACH-105375]

Responsible: Prof. Dr.-Ing. Thomas Breitling
Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153425	Industrial aerodynamics	2 SWS		Breitling
Exams					
WS 19/20	76-T-MACH-105375	Industrial Aerodynamics		Prüfung (PR)	Breitling

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Industrial aerodynamics
2153425, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Power Point

Notes
This compact lecture deals with flow, mixing and combustion phenomena with significance in vehicle development. A special focus is set on the optimization of external car and truck aerodynamics, thermal comfort in passenger compartments, analyses of cooling flows and improvement of charge motion, mixing and combustion in piston engines. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. The focus of this lecture is on industry relevant methods for analyses and description of forces, flow structures, turbulence, flows with heat transfer and phase transition and reactive flows. In addition an introduction to modern methods in accuracy control and efficiency improvement of numerical methods for industrial use is given. The integration and interconnection of the methods in the development processes are discussed examplary.
An excursion to the Daimler AG wind tunnel and the research and development centers is planned.

- Industrial flow measurement techniques
- Flow simulation and control of numerical errors, turbulence modeling
- Cooling flows
- Flow mixing and combustation at direct injected Diesel engines
- Flow mixing and combustation at gasoline engine
- Vehicle aerodynamics
- HVAC-Systems and thermal comfort
- Aeroacoustics

Students can describe the different challenges of aerdynamical flow that occur in vehicles. They are qualified to analyze external flows around the vehicles, flows in the passenger compartments (thermal comfort), as well as cooling flows, charge motion, mixing and combustion processes in the engine.

Learning Content

This compact lecture deals with flow, mixing and combustion phenomena with significance in vehicle development. A special focus is set on the optimization of external car and truck aerodynamics, thermal comfort in passenger compartments, analyses of cooling flows and improvement of charge motion, mixing and combustion in piston engines. These fields are explained in their phenomenology, the corresponding theories are discussed and the tools for measurement and simulation are introduced and demonstrated. The focus of this lecture is on industry relevant methods for analyses and description of forces, flow structures, turbulence, flows with heat transfer and phase transition and reactive flows. In addition an introduction to modern methods in accuracy control and efficiency improvement of numerical methods for industrial use is given. The integration and interconnection of the methods in the development processes are discussed examplary.
An excursion to the Daimler AG wind tunnel and the research and development centers is planned.

- Industrial flow measurement techniques
- Flow simulation and control of numerical errors, turbulence modeling
- Cooling flows
- Flow mixing and combustation at direct injected Diesel engines
- Flow mixing and combustation at gasoline engine
- Vehicle aerodynamics
- HVAC-Systems and thermal comfort
- Aeroacoustics

Annotation

Block course with limited number of participants, registration in the secretary's office required. See details at www.istm.kit.edu

Workload

attendance: 22.5h

self-study: 100h

Literature

Script

T 3.152 Course: Industrial Application of Material Handling Systems in Sorting and Distribution Systems [T-MACH-102092]

Responsible: Dr.-Ing. Jörg Föller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Competence Certificate
oral 30 min

Prerequisites
none

T 3.153 Course: Information Processing in Mechatronic Systems [T-MACH-105328]

Responsible: Prof. Dr.-Ing. Michael Kaufmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2105022	Information Processing in Mechatronic Systems	2 SWS	Lecture (V)	Kaufmann

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Information Processing in Mechatronic Systems

2105022, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

Information processing components – consisting of sensors, actors, hardware and software – are of essential importance for the implementation of mechatronic functions.

Based on requirements on information processing in mechatronic systems typical hardware and software solutions are examined. Characteristics, advantages, disadvantages and application areas are discussed. Solutions are examined regarding real-time capabilities, dependability, safety and fault tolerance. Bus communication in mechatronic systems is examined. Description methods and several approaches of functional description are considered. An approach on the development of information processing components is developed. Lecture topics are complemented by practical examples.

Outline:

- Requirements on information processing components,
- Characteristics of information processing components
- Real-time capabilities, dependability, safety and fault tolerance
- Architectures of information processing components
- Communication in mechatronic systems
- Descriptive models und functional description
- Development of information processing components
- Software quality

Learning objectives:

Students have fundamental knowledge about selection, conceptual design and development of information processing components in mechatronic systems.

Learning Content
Information processing components – consisting of sensors, actors, hardware and software – are of essential importance for the implementation of mechatronic functions.

Based on requirements on information processing in mechatronic systems typical hardware and software solutions are examined. Characteristics, advantages, disadvantages and application areas are discussed. Solutions are examined regarding real-time capabilities, dependability, safety and fault tolerance. Bus communication in mechatronic systems is examined. Description methods and several approaches of functional description are considered. An approach on the development of information processing components is developed. Lecture topics are complemented by practical examples.

Outline:

- Requirements on information processing components,
- Characteristics of information processing components
- Real-time capabilities, dependability, safety and fault tolerance
- Architectures of information processing components
- Communication in mechatronic systems
- Descriptive models und functional description
- Development of information processing components
- Software quality

Workload
General attendance: 21 h

Self-study: 99 h

3.154 Course: Information Processing in Sensor Networks [T-INFO-101466]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Oral examination	6	Irregular	1

Events					
WS 19/20	24102	Information Processing in Sensor Networks	3 SWS	Lecture (V)	Noack, Mayer, Hanebeck
Exams					
SS 2019	7500011	Information Processing in Sensor Networks		Prüfung (PR)	Hanebeck, Noack
WS 19/20	7500030	Information Processing in Sensor Networks		Prüfung (PR)	Noack, Hanebeck

T 3.155 Course: Information Systems and Supply Chain Management [T-MACH-102128]

Responsible: Dr. Christoph Kilger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	2

Events					
SS 2019	2118094	Information Systems in Logistics and Supply Chain Management	2 SWS	Lecture (V)	Kilger
Exams					
SS 2019	76-T-MACH-102128	Information Systems and Supply Chain Management		Prüfung (PR)	Mittwollen

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Information Systems in Logistics and Supply Chain Management
2118094, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations

Learning Content
1) Overview of logistics systems and processes

2) Basic concepts of information systems and information technology

3) Introduction to IS in logistics: Overview and applications

4) Detailed discussion of selected SAP modules for logistics support

Annotation
none

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
Stadtler, Kilger: Supply Chain Management and Advanced Planning, Springer, 4. Auflage 2008

T 3.156 Course: Innovative Nuclear Systems [T-MACH-105404]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130973	Innovative Nuclear Systems	2 SWS		Cheng
Exams					
SS 2019	76-T-MACH-105404	Innovative Nuclear Systems		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Innovative Nuclear Systems
2130973, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

1. state of the art and development tendencies in nuclear systems
2. advanced concepts in light water cooled systems
3. new developments in fast reactors
4. development tendencies in gas-cooled plants
5. transmutation systems for waste management
6. fusionsystems

Workload
Time of attendance: 21 hours
Self-study: 100 hours

T 3.157 Course: Innvative Project [T-MACH-109185]

Responsible: Prof. Dr. Andreas Class
Prof. Dr. Orestis Terzidis

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Examination of another type	6	Each winter term	1

Events					
WS 19/20	2169466	Innovative Project	3 SWS		Class, Terzidis

Competence Certificate
Students have to deliver pitch-talk supported by slides to convience a commity about their results. A fictive project proposal of 10 to 15 pages.

Prerequisites
none

Recommendation
Participates need to bring there own laptop with Skype installed.

Recommended English profiency äquivalent to:

- IELTS Academic test
  An overall band score of at least 6.5 (with no section lower than 5.5)
- University of Cambridge
  Certificate in Advanced English, CAE (grades A – C)
  Certificate of Proficiency in English, CPE (grades A – C)
- TOEFL Internet-based test, IBT
  A total score of at least 92, with a minimum score of 22 from the writing section

Annotation
The subject of the project is provided by industry partner or the innovation department from KIT or INP Grenoble. Representatives of industry partner will be addressee for the pitch-talk.

Below you will find excerpts from events related to this course:

V Innovative Project
2169466, WS 19/20, 3 SWS, Language: English, Open in study portal

Notes

The lecture will be executed with the partner university INP Grenoble. Participates need to bring there own laptop with Skype installed. Teams of 2-3 students.

- Understand the physics of the technology of the invention considered in the project
- Understand the claims of the patent considered in the project
- Apply a structured technology application selection methodology.
- Student understand the methodology of TAS, which provides the background to become a TAS coach.
- Students are enabled to prepare a proposal for funding.

The TAS (technology application selection) methodology provides tools that help to successfully advance an invention with a low technology readiness level to a higher technology readiness level. Skills that are typically provided by a classical engineering education supports both the early phase of an invention where a deep basic understanding is required and the industrial exploration building on a first prototype. The gap that arises between the invention and its later industrialized application is rarely addressed, so that many inventions will not make it to the market. In the course, we practice bridging the technology gap for the case of a real invention provided by an industry partner or University. We experiment with teams consisting of team members located at different universities and from different disciplines.

The scenario addressed is an inventor who calls some of his friends within her/his personal network. The group will work remotely via video conference employing a structured TAS process. Creativity will be fertilized by teamwork and linking the invention to a selection of potential technologies. In an in-depth analysis of these links, each group narrows down their pool of ideas to one candidate. Finally, the group will try to convince the fellow teams (and the inventor) to support their idea. For this purpose, a pitch talk is prepared and delivered in front of all teams leading to a unique vote of all teams for one technology application. In addition the students prepare fictive proposals for start-up based on their TAS.

Learning Content

The TAS (technology application selection) methodology provides tools that help to successfully advance an invention with a low technology readiness level to a higher technology readiness level. Skills that are typically provided by a classical engineering education supports both the early phase of an invention where a deep basic understanding is required and the industrial exploration building on a first prototype. The gap that arises between the invention and its later industrialized application is rarely addressed, so that many inventions will not make it to the market. In the course, we practice bridging the technology gap for the case of a real invention provided by an industry partner or University. We experiment with teams consisting of team members located at different universities and from different disciplines.

The scenario addressed is an inventor who calls some of his friends within her/his personal network. The group will work remotely via video conference employing a structured TAS process. Creativity will be fertilized by teamwork and linking the invention to a selection of potential technologies. In an in-depth analysis of these links, each group narrows down their pool of ideas to one candidate. Finally, the group will try to convince the fellow teams (and the inventor) to support their idea. For this purpose, a pitch talk is prepared and delivered in front of all teams leading to a unique vote of all teams for one technology application. In addition the students prepare fictive proposals for start-up based on their TAS.

Annotation

The subject of the project is provided by industry partner or the innovation department from KIT or INP Grenoble. Representatives of industry partner will be addressee for the pitch-talk.

Workload

approx. 180 hours:

3 credit points - skype participation and resulting in TAS - 90 hours

1 credit point - pitch talk - 30 hours

2 credit points - for writting proposal - 60 hours

T 3.158 Course: Integrated Information Systems for Engineers [T-MACH-102083]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2121001	Integrated Information Systems for engineers	3 SWS	Lecture / Practice (VÜ)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102083	Integrated Information Systems for Engineers		Prüfung (PR)	Ovtcharova, Elstermann

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Integrated Information Systems for engineers
2121001, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Workload
Regular attendance: 31,5 hours, self-study: 108 hours

Literature
Lecture slides

T 3.159 Course: Integrated Production Planning in the Age of Industry 4.0 [T-MACH-108849]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2150660	Integrated Production Planning in the Age of Industry 4.0	6 SWS	Lecture / Practice (VÜ)	Lanza
Exams					
SS 2019	76-T-MACH-108849	Integrated Production Planning in the Age of Industry 4.0		Prüfung (PR)	Lanza

Competence Certificate
Oral Exam (40 min)

Prerequisites
"T-MACH-109054 - Integrierte Produktionsplanung im Zeitalter von Industrie 4.0" as well as "T-MACH-102106 Integrierte Produktionsplanung" must not be commenced.

Below you will find excerpts from events related to this course:

V Integrated Production Planning in the Age of Industry 4.0 — Lecture / Practice (VÜ)
2150660, SS 2019, 6 SWS, Language: German, Open in study portal

Description
Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
- Principles of integrated production systems and further development with Industry 4.0

Building on this, the phases of integrated production planning are taught in accordance with VDI Guideline 5200, whereby special features of parts production and assembly are dealt with in the context of case studies:

- Factory planning system
- Definition of objectives
- Data collection and analysis
- Concept planning (structural development, structural dimensioning and rough layout)
- Detailed planning (production planning and control, fine layout, IT systems in an industry 4.0 factory)
- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Learning Outcomes:

The students ...

- can discuss basic questions of production technology.
- are able to apply the methods of integrated production planning they have learned about to new problems.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about for a specific problem.
- can apply the learned methods of integrated production planning to new problems.
- can use their knowledge targeted for efficient production technology.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours
WING:
regular attendance: 63 hours
self-study: 207 hours

Learning Content

Integrated production planning in the age of industry 4.0 will be taught in the context of this engineering science lecture. In addition to a comprehensive introduction to Industry 4.0, the following topics will be addressed at the beginning of the lecture:

- Basics, history and temporal development of production
- Integrated production planning and integrated digital engineering
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- Preparation and monitoring of implementation
- Start-up and series support

The lecture contents are rounded off by numerous current practical examples with a strong industry 4.0 reference. Within the exercises the lecture contents are deepened and applied to specific problems and tasks.

Workload

MACH:
regular attendance: 63 hours
self-study: 177 hours
WING:
regular attendance: 63 hours
self-study: 207 hours

Literature

Lecture Notes

T 3.160 Course: Integrative Strategies in Production and Development of High Performance Cars [T-MACH-105188]

Responsible: Karl-Hubert Schlichtenmayer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2150601	Integrative Strategies in Production and Development of High Performance Cars	2 SWS	Lecture (V)	Schlichtenmayer
Exams					
SS 2019	76-T-MACH-105188	Integrative Strategies in Production and Development of High Performance Cars		Prüfung (PR)	Lanza

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Integrative Strategies in Production and Development of High Performance Cars — Lecture (V)
2150601, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:
Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/).

Notes
The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

- Introduction to social trends towards high performance cars
- Automotive Production Processes
- Integrative R&D strategies and holistic capacity management
- Management of complex projects
- Interlinkage between R&D, production and purchasing
- The modern role of manufacturing from a R&D perspective
- Global R&D and production
- Methods to identify core competencies

Learning Outcomes:

The students ...

- are capable to specify the current technological and social challenges in automotive industry.
- are qualified to identify interlinkages between development processes and production systems.
- are able to explain challenges and solutions of global markets and global production of premium products.
- are able to explain modern methods to identify key competences of producing companies.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content
The lecture deals with the technical and organizational aspects of integrated development and production of sports cars on the example of Porsche AG. The lecture begins with an introduction and discussion of social trends. The deepening of standardized development processes in the automotive practice and current development strategies follow. The management of complex development projects is a first focus of the lecture. The complex interlinkage between development, production and purchasing are a second focus. Methods of analysis of technological core competencies complement the lecture. The course is strongly oriented towards the practice and is provided with many current examples.

The main topics are:

- Introduction to social trends towards high performance cars
- Automotive Production Processes
- Integrative R&D strategies and holistic capacity management
- Management of complex projects
- Interlinkage between R&D, production and purchasing
- The modern role of manufacturing from a R&D perspective
- Global R&D and production
- Methods to identify core competencies

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
Lecture Slides

T 3.161 Course: Intellectual Property Rights and Strategies in Industrial Companies [T-MACH-105442]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Frank Zacharias

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2147160	Patents and Patentstrategies in innovative companies	2 SWS		Zacharias
WS 19/20	2147161	Intellectual Property Rights and Strategies in Industrial Companies	2 SWS	Lecture (V)	Zacharias

Competence Certificate
oral exam (20 min)

Prerequisites
none

Recommendation
None

Below you will find excerpts from events related to this course:

V Patents and Patentstrategies in innovative companies

2147160, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media

- Beamer

Notes

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

The students understand and are able to describe the basics of intellectual property, particularly with regard to the filing and obtaining of property rights. They can name the criteria of project-integrated intellectual property management and strategic patenting in innovative companies. Students are also able to describe the key regulations of the law regarding employee invention and to illustrate the challenges of intellectual properties with reference to examples.

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual

property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Learning Content

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual

property and current trends in the sector. Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

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2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Workload

Attendance at lectures (5 L): 24h

Personal preparation and follow-up of lecture and exercise: 5h

Preparation exam: 31h

V	**Intellectual Property Rights and Strategies in Industrial Companies** 2147161, WS 19/20, 2 SWS, Language: German, Open in study portal	**Lecture (V)**

Learning Content

The lecture will describe the requirements to be fulfilled and how protection is obtained for patents, design rights and trademarks, with a particular focus on Germany, Europe and the EU. Active, project-integrated intellectual property management and the use of strategic patenting by technologically oriented companies will also be discussed. Furthermore, the significance of innovations and intellectual property for both business and industry will be demonstrated using practical examples, before going on to consider the international challenges posed by intellectual property and current trends in the sector.

Within the context of licensing and infringement, insight will be provided as to the relevance of communication, professional negotiations and dispute resolution procedures, such as mediation for example. The final item on the agenda will cover those aspects of corporate law that are relevant to intellectual property.

Lecture overview:

1. Introduction to intellectual property
2. The profession of the patent attorney
3. Filing and obtaining intellectual property rights
4. Patent literature as a source of knowledge and information
5. The law regarding employee inventions
6. Active, project-integrated intellectual property management
7. Strategic patenting
8. The significance of intellectual property
9. International challenges and trends
10. Professional negotiations and dispute resolution procedures
11. Aspects of corporate law

Workload

regular attendance: 21 h

self-study: 99 h

T 3.162 Course: Introduction into Mechatronics [T-MACH-100535]

Responsible: Moritz Böhland
Dr.-Ing. Maik Lorch
PD Dr.-Ing. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	2

Events					
WS 19/20	2105011	Introduction into Mechatronics	3 SWS	Lecture (V)	Reischl, Lorch, Böhland
Exams					
SS 2019	76-T-MACH-100535	Introduction into Mechatronics		Prüfung (PR)	Reischl

Competence Certificate
Oral exam (Duration: 2h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Introduction into Mechatronics

2105011, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

- Introduction
- Structure of mechatronic systems
- Mathematical treatment of mechatronic systems
- Sensors and actuators
- Measurements: acquisition and interpretation
- Modelling of mechatronic systems
- Control and feedback control systems
- Information processing

Learning objectives:

The student has knowledge about the specific challenge of interdisciplinary collaboration within the framework of mechatronics. He is able to explain the origin, necessity and methodic implementation of interdisciplinary collaboration, to name the main difficulties as well as the special features within the development of mechatronic products from the point of view of development methodic.

The student has fundamental knowledge of modeling mechanical, hydraulically and electrically part systems and about suitable optimization methods.

The student knows the difference in use of the term "system" in mechatronic and mechanical use.

Learning Content

- Introduction
- Structure of mechatronic systems
- Mathematical treatment of mechatronic systems
- Sensors and actuators
- Measurements: acquisition and interpretation
- Modelling of mechatronic systems
- Control and feedback control systems
- Information processing

Workload
regular attendance: 31.5 h

self-study: 148 h

Literature
Heimann, B.; Gerth, W.; Popp, K.: Mechatronik. Leipzig: Hanser, 1998
Isermann, R.: Mechatronische Systeme - Grundlagen. Berlin: Springer, 1999
Roddeck, W.: Einführung in die Mechatronik. Stuttgart: B. G. Teubner, 1997
Töpfer, H.; Kriesel, W.: Funktionseinheiten der Automatisierungstechnik. Berlin: Verlag Technik, 1988
Föllinger, O.: Regelungstechnik. Einführung in die Methoden und ihre Anwendung. Heidelberg: Hüthig, 1994
Bretthauer, G.: Modellierung dynamischer Systeme. Vorlesungsskript. Freiberg: TU Bergakademie, 1997

T 3.163 Course: Introduction into the Multi-Body Dynamics [T-MACH-105209]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

Events					
SS 2019	2162235	Introduction into the multi-body dynamics	3 SWS	Lecture (V)	Seemann
Exams					
SS 2019	76-T-MACH-105209	Introduction into the Multi-Body Dynamics		Prüfung (PR)	Seemann

Competence Certificate
Written examination, 180 min.

Prerequisites
none

Recommendation
Engineering Mechanics III/IV

Below you will find excerpts from events related to this course:

V Introduction into the multi-body dynamics
2162235, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The role of multibody systems in engineering, kinematics of a single rigid body, Kinematics of multibody systems, rotation matrix, angular velocity, derivatives in different reference systems, holonomic and non-holonomic constraints, Newton-Euler's equations, principle of d'Alembert, principle of virtuel power, Lagrange's equations, Kane's equations, structure of the equations of motion

Workload
time of attendance: 21,5h; self-study: 98h

Literature
Wittenburg, J.: Dynamics of Systems of Rigid Bodies, Teubner Verlag, 1977
Roberson, R. E., Schwertassek, R.: Dynamics of Multibody Systems, Springer-Verlag, 1988
de Jal'on, J. G., Bayo, E.: Kinematik and Dynamic Simulation of Multibody System.
Kane, T.: Dynamics of rigid bodies.

T 3.164 Course: Introduction to Ceramics [T-MACH-100287]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2125757	Introduction to Ceramics	3 SWS	Lecture (V)	Hoffmann
Exams					
SS 2019	76-T-MACH-100287	Introduction to Ceramics		Prüfung (PR)	Hoffmann, Schell, Wagner
WS 19/20	76-T-MACH-100287	Introduction to Ceramics		Prüfung (PR)	Hoffmann, Schell, Wagner

Competence Certificate
The assessment consists of an oral exam (30 min) taking place at a specific date.

The re-examination is offered at a specific date.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Introduction to Ceramics

2125757, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Slides for the lecture:

available under http://www.iam.kit.edu/km

Learning Content
After a short introduction to interatomic bonding, fundamental concepts of crystallography, the stereographic projection and the most important symmetry elements will be given. Different types of crystal structures are explained and the relevance of imperfections are analysed with respect to the mechanical and electrical properties of ceramics. Then, the impact of surfaces, interfaces and grain boundaries for the preparation, microstructural evolution and the resulting properties is discussed. Finally, an introduction is given to ternary phase diagrams.

The second part of the course covers structure, preparation and application aspects of nonmetallic inorganic glasses, followed by an introduction to the properties and processing methods of fine-grained technical powders. The most relevant shaping methods, such as pressing, slip casting, injection moulding and extrusion are introduced. Subsequently, the basics of science of sintering and the mechanisms for normal and abnormal grain growth are discussed. Mechanical properties of ceramics are analysed using basic principles of linear elastic fracture mechanics, Weibull statistics, concepts for subcritical crack growth and creep models to explain the behaviour at elevated temperatures. Furthermore it is demonstrated that mechanical properties can be siginificantly enhanced by various types of microstructural toughening mechanisms. The electronic and ionic conductivity of ceramic materials are explained based on defect-chemical considerations and band structure models. Finally, the characteristics of a dielectric, pyroelectric, and piezoelectric behaviour is discussed.

Workload
regular attendance: 45 hours
self-study: 135 hours

Literature

- H. Salmang, H. Scholze, "Keramik", Springer
- Kingery, Bowen, Uhlmann, "Introduction To Ceramics", Wiley
- Y.-M. Chiang, D. Birnie III and W.D. Kingery, "Physical Ceramics", Wiley
- S.J.L. Kang, "Sintering, Densification, Grain Growth & Microstructure", Elsevier

T 3.165 Course: Introduction to Engineering Mechanics I: Statics [T-MACH-108808]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	2162238	Introduction to Engineering Mechanics I: Statics and Strength of Materials	2 SWS	Lecture (V)	Fidlin
SS 2019	2162239	Übungen zu Einführung in die Technische Mechanik I: Statik und Festigkeitslehre	1 SWS	Practice (Ü)	Fidlin, Drozdetskaya

Competence Certificate
The assessment consists of a written examination taking place in the recess period (according to Section 4(2), 1 of the examination regulation). The examination takes place in every semester. Re-examinations are offered at eyery ordinary examination date.

Permitted utilities: none

Prerequisites
None

Below you will find excerpts from events related to this course:

V Introduction to Engineering Mechanics I: Statics and Strength of Materials
Lecture (V)
2162238, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Statics: force · moment · general equilibrium condistions · center of mass · inner force in structure · plane frameworks · theory of adhesion

T 3.166 Course: Introduction to Engineering Mechanics I: Statics and Strength of Materials [T-MACH-102208]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

Events					
SS 2019	2162238	Introduction to Engineering Mechanics I: Statics and Strength of Materials	2 SWS	Lecture (V)	Fidlin
SS 2019	2162239	Übungen zu Einführung in die Technische Mechanik I: Statik und Festigkeitslehre	1 SWS	Practice (Ü)	Fidlin, Drozdetskaya
Exams					
SS 2019	76-T-MACH-102208-1	Introduction to Engineering Mechanics I: Statics(75 Min)		Prüfung (PR)	Fidlin
SS 2019	76-T-MACH-102208-2	Introduction to Engineering Mechanics I: Statics and Strength of Materials (120 Min)		Prüfung (PR)	Fidlin

Competence Certificate
The assessment consists of a written examination (120 min) taking place in the recess period (according to Section 4(2), 1 of the examination regulation). The examination takes place in every semester. Re-examinations are offered at eyery ordinary examination date.

For students of economics the assessement consists of a written examination (Statics - 75 min.)

Permitted utilities: non-programmable calculator

Prerequisites
None

Below you will find excerpts from events related to this course:

V Introduction to Engineering Mechanics I: Statics and Strength of Materials — Lecture (V)
2162238, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Statics: force · moment · general equilibrium condistions · center of mass · inner force in structure · plane frameworks · theory of adhesion

T 3.167 Course: Introduction to Industrial Production Economics [T-MACH-105388]

Responsible: Simone Dürrschnabel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
none

T 3.168 Course: Introduction to Microsystem Technology I [T-MACH-105182]

Responsible: Dr. Vlad Badilita
Dr. Mazin Jouda
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2141861	Introduction to Microsystem Technology I	2 SWS	Lecture (V)	Korvink, Badilita
Exams					
SS 2019	76-T-MACH-105182	Introduction to Microsystem Technology I		Prüfung (PR)	Korvink, Badilita

Competence Certificate
written examination for implementation in a major field, 30 min oral exam for elective subject

Prerequisites
none

Below you will find excerpts from events related to this course:

V Introduction to Microsystem Technology I

2141861, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
- Introduction in Nano- and Microtechnologies
- Silicon and processes for fabricating microelectronics circuits
- Basic physics background and crystal structure
- Materials for micromachining
- Processing technologies for microfabrication
- Silicon micromachining
- Examples

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature
M. Madou
Fundamentals of Microfabrication
Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

T 3.169 Course: Introduction to Microsystem Technology II [T-MACH-105183]

Responsible: Dr. Mazin Jouda
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2142874	Introduction to Microsystem Technology II	2 SWS	Lecture (V)	Korvink, Badilita
Exams					
SS 2019	76-T-MACH-105183	Introduction to Microsystem Technology II		Prüfung (PR)	Korvink, Badilita

Competence Certificate
written examination for major field, oral exam (30 min) for elective field

Prerequisites
none

Below you will find excerpts from events related to this course:

V Introduction to Microsystem Technology II

Lecture (V)

2142874, SS 2019, 2 SWS, Language: English, Open in study portal

Learning Content
- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

Workload
Literature: 20 h

Lessions: 21 h

Preparation and Review: 50 h

Exam preparation: 30 h

Literature
M. Madou
Fundamentals of Microfabrication
Taylor & Francis Ltd.; Auflage: 3. Auflage. 2011

T 3.170 Course: Introduction to Neutron Cross Section Theory and Nuclear Data Generation [T-MACH-105466]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190490	Introduction to Neutron Cross Section Theory and Nuclear Data Generation	2 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105466	Introduction to Neutron Cross Section Theory and Nuclear Data Generation		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

Below you will find excerpts from events related to this course:

V Introduction to Neutron Cross Section Theory and Nuclear Data Generation

Lecture (V)

2190490, SS 2019, 2 SWS, Language: English, Open in study portal

Notes

Cross section characterization

Summary of basic cross section theory

Resonance cross section

Doppler broadening

Scattering kernels

Basic of slowing down theory

Unit cell based XS data generation

Cross sections Data libraries

Data Measurements

The students:

- Understand the special importance of cross sections in various domains of natural science (Reactor physics, Material research, Solar radiation etc.)
- Are familiar with the theoretical methods and experimental effort to generate cross sections data.

Regular attendance: 26 h

self study: 94 h

oral exam about 30 min.

Learning Content

Cross section characterization

Summary of basic cross section theory

Resonance cross section

Doppler broadening

Scattering kernels

Basic of slowing down theory

Unit cell based XS data generation

Cross sections Data libraries

Data Measurements

Workload

Regular attendance: 26 h

self study: 94 h

Literature

Handbook of Nuclear Reactors Calculations Vol. I Y. Ronen, CRC Press 1986

D. Emendorfer. K.H. Höcker Theory of nuclear reactions, Parts I, II BI- Hochschultaschenbücher 1969 (in German)

P. Tippler, R. Llewellyn Modern Physics 2008

T 3.171 Course: Introduction to Nonlinear Vibrations [T-MACH-105439]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	7	Each winter term	1

Events					
WS 19/20	2162247	Introduction to Nonlinear Vibrations	2 SWS	Lecture (V)	Fidlin
WS 19/20	2162248	Introduction into the nonlinear vibrations (Tutorial)	2 SWS	Practice (Ü)	Fidlin, Schröders

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory, Dynamic Stability

Below you will find excerpts from events related to this course:

V Introduction to Nonlinear Vibrations

2162247, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- dynamic systems
- basic ideas of asymptotic methods
- perturbation methods: Linstedt-Poincare, averaging, multiple scales
- limit cycles
- nonlinear resonance
- basics of the bifurcation analysis, bifurcation diagrams
- types of bifurcations
- discontinuous systems
- dynamic chaos

Workload
time of attendance: 39 h
self-study: 201 h

Literature

- Hagedorn P. Nichtlineare Schwingungen. Akademische Verlagsgesellschaft, 1978.
- Nayfeh A.H., Mook D.T. Nonlinear Oscillation. Wiley, 1979.
- Thomsen J.J. Vibration and Stability, Order and Chaos. McGraw-Hill, 1997.
- Fidlin A. Nonlinear Oscillations in Mechanical Engigeering. Springer, 2005.
- Bogoliubov N.N., Mitropolskii Y.A. Asymptotic Methods in the Theory of Nonlinear Oscillations. Gordon and Breach, 1961.
- Nayfeh A.H. Perturbation Methods. Wiley, 1973.
- Sanders J.A., Verhulst F. Averaging methods in nonlinear dynamical systems. Springer-Verlag, 1985.
- Blekhman I.I. Vibrational Mechanics. World Scientific, 2000.
- Moon F.C. Chaotic Vibrations – an Introduction for applied Scientists and Engineers. John Wiley & Sons, 1987.

V **Introduction into the nonlinear vibrations (Tutorial)** **Practice (Ü)**
2162248, WS 19/20, 2 SWS, Language: German, Open in study portal

Workload
time of attendance: 10,5h; self-study: 20h

T 3.172 Course: Introduction to Nuclear Energy [T-MACH-105525]

Responsible: Prof. Dr.-Ing. Xu Cheng
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189903	Introduction to Nuclear Energy	2 SWS	Lecture (V)	Cheng
Exams					
SS 2019	76-T-MACH-105525	Introduction to Nuclear Energy		Prüfung (PR)	Cheng

Competence Certificate
oral exam, 30 min

Prerequisites
none

T 3.173 Course: Introduction to numerical mechanics [T-MACH-108718]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Exams				
SS 2019	76-T-MACH-108718	Introduction to numerical mechanics	Prüfung (PR)	

Competence Certificate
Oral Exam, 20 minutes

Prerequisites
None

Annotation
The lecture notes are made available via ILIAS.

T 3.174 Course: Introduction to Operations Research I and II [T-WIWI-102758]

Responsible: Prof. Dr. Stefan Nickel
Prof. Dr. Steffen Rebennack
Prof. Dr. Oliver Stein

Organisation: KIT Department of Economics and Management

Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	9	see Annotations	1

Events					
SS 2019	2550040	Introduction to Operations Research I	2+2 SWS	Lecture (V)	Stein
WS 19/20	2530043	Introduction to Operations Research II	2 SWS	Lecture (V)	Stein
WS 19/20	2530044		2 SWS	Tutorial (Tu)	Assistenten, Stein
Exams					
SS 2019	7900135	Introduction to Operations Research I and II		Prüfung (PR)	Nickel

Competence Certificate
The assessment of the module is carried out by a written examination (120 minutes) according to Section 4(2), 1 of the examination regulation.

In each term (usually in March and July), one examination is held for both courses.

The overall grade of the module is the grade of the written examination.

Prerequisites
None

Recommendation
Mathematics I und II. Programming knowledge for computing exercises.

It is strongly recommended to attend the course *Introduction to Operations Research I* [2550040] before attending the course*Introduction to Operations Research II* [2530043].

Below you will find excerpts from events related to this course:

V Introduction to Operations Research I

Lecture (V)

2550040, SS 2019, 2+2 SWS, Language: German, Open in study portal

Description
Examples for typical OR problems.

Linear Programming: Basic notions, simplex method, duality, special versions of the simplex method (dual simplex method, three phase method), sensitivity analysis, parametric optimization, game theory.

Graphs and Networks: Basic notions of graph theory, shortest paths in networks, project scheduling, maximal and minimal cost flows in networks.

Learning Content
Examples for typical OR problems.

Linear Programming: Basic notions, simplex method, duality, special versions of the simplex method (dual simplex method, three phase method), sensitivity analysis, parametric optimization, multicriteria optimization.

Graphs and Networks: Basic notions of graph theory, shortest paths in networks, project scheduling, maximal flows in networks.

Workload
Berechnung des Arbeitsaufwands eines durchschnittlichen Studenten um die Lernziele zu erreichen. (Intern)

Eine Vernetzung von learningoutcomes (Wissen (content), Kompetenzen (skills) und levels mit dem dafür geschätzten Arbeitsaufwand eines durchschnittlichen Studenten ist anzustreben.

Literature

- Nickel, Stein, Waldmann: Operations Research, 2nd edition, Springer, 2014
- Hillier, Lieberman: Introduction to Operations Research, 8th edition. McGraw-Hill, 2005
- Murty: Operations Research. Prentice-Hall, 1995
- Neumann, Morlock: Operations Research, 2. Auflage. Hanser, 2006
- Winston: Operations Research - Applications and Algorithms, 4th edition. PWS-Kent, 2004

T 3.175 Course: Introduction to the Finite Element Method [T-MACH-105320]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Dr.-Ing. Tom-Alexander Langhoff

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	3

Events					
SS 2019	2162282	Introduction to the Finite Element Method	2 SWS	Lecture (V)	Langhoff, Böhlke
Exams					
SS 2019	76-T-MACH-105320	Introduction to the Finite Element Method		Prüfung (PR)	Böhlke, Langhoff

Competence Certificate
written exam (90 min)

Prerequisites
Passing the Tutorial "Introduction to the Finite element method" (T-MACH-110330) is a prerequisite for taking part in the exam.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110330 - Tutorial Introduction to the Finite Element Method must have been passed.

Annotation
Knowledge of the contents of the courses "Continuum Mechanics of Solids and Fluids" and "Mathematical Methods of Continuum Mechanics" as well as the corresponding tutorials are expected

The assignment of the restricted places in the associated Lab Course is crucial to the institute.

Below you will find excerpts from events related to this course:

V Introduction to the Finite Element Method
2162282, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- introduction and motivation, elements of tensor calculus
- Discrete FEM: systems of bars and springs
- Formulations of boundary value problems (1D)
- Approximations in FEM
- FEM for scalar and vector-valued field problems
- Solution methods for linear systems of equations

T 3.176 Course: Introduction to Theory of Materials [T-MACH-105321]

Responsible: Prof. Dr. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2182732	Introduction to Theory of Materials	2 SWS	Lecture (V)	Kamlah
Exams					
SS 2019	76-T-MACH-105321	Introduction to Theory of Materials		Prüfung (PR)	Kamlah

Competence Certificate
oral exam

Below you will find excerpts from events related to this course:

V Introduction to Theory of Materials

Lecture (V)

2182732, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Following a brief introduction into continuum mechanics at small deformations, the classification into elastic, viscoelastic, plastic and viscoplastic constitutive models of solids is discussed. Then, one after the other, the four groups of elastic, viscoelastic, plastic and viscoplastic constitutive models are motivated and mathematically formulated. Their properties are demonstrated by means of elementary analytical solutions and examples.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
[1] Peter Haupt: Continuum Mechanics and Theory of Materials, Springer
[2] Lecture Notes

T 3.177 Course: IoT Platform for Engineering [T-MACH-106743]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2123352	IoT platform for engineering	3 SWS		Ovtcharova, Maier
WS 19/20	2123352	IoT platform for engineering	SWS		Ovtcharova, Maier

Competence Certificate
Assessment of another type (graded), procedure see webpage. Number of participants limited to 20 people. There is a participant selection process.

Below you will find excerpts from events related to this course:

V IoT platform for engineering
2123352, SS 2019, 3 SWS, Open in study portal

Notes
Number of participants limited to 15 people. There is a participant selection process.

V IoT platform for engineering
2123352, WS 19/20, SWS, Language: German, Open in study portal

Learning Content
Industry 4.0, IT systems for fabrication and assembly, process modelling and execution, project work in teams, practice-relevant I4.0 problems, in automation, manufacturing industry and service.

T 3.178 Course: Lab Computer-Aided Methods for Measurement and Control [T-MACH-105341]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2137306	Lab Computer-aided methods for measurement and control	3 SWS	Practical course (P)	Stiller, Richter

Competence Certificate
Colloquia

Prerequisites
none

Below you will find excerpts from events related to this course:

V Lab Computer-aided methods for measurement and control

2137306, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes
Lerninhalt (EN):

1. Digital technology
2. Digital storage oscilloscope and digital spectrum analyzer
3. Supersonic computer tomography
4. Lighting and image acquisition
5. Digital image processing
6. Image interpretation
7. Control synthesis and simulation
8. Robot: Sensors
9 Robot: Actuating elements and path planning
The lab comprises 9 experiments.

Voraussetzungen: Recommendations:

Basic studies and preliminary examination; basic lectures in automatic control

Arbeitsaufwand (EN): 120 hours

Lernziele (EN):

Powerful and cheap computation resources have led to major changes in the domain of measurement
and control. Engineers in various fields are nowadays confronted with the application of computer-aided methods. This lab tries to give an insight into the modern domain of measurement and control by means of practically oriented and flexible experiments. Based on experiments
on measurement instrumentation and digital signal processing, elementary knowledge in the domain of visual inspection and image processing will be taught. Thereby, commonly used software like MATLAB/Simulink will be used in both simulation and realization of control loops. The lab closes with selected applications, like control of a robot or supersonic computer
tomography.

Learning Content
1. Digital technology
2. Digital storage oscilloscope and digital spectrum analyzer
3. Supersonic computer tomography
4. Lighting and image acquisition
5. Digital image processing
6. Image interpretation
7. Control synthesis and simulation
8. Robot: Sensors
9 Robot: Actuating elements and path planning
The lab comprises 9 experiments.

Workload
120 hours

Literature
Instructions to the experiments are available on the institute's website

T 3.179 Course: Laboratory Exercise in Energy Technology [T-MACH-105331]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Prof. Dr. Ulrich Maas
Heiner Wirbser

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2171487	Laboratory Exercise in Energy Technology	3 SWS	Practical course (P)	Bauer, Maas, Bykov
WS 19/20	2171487	Laboratory Exercise in Energy Technology	3 SWS	Practical course (P)	Bauer, Maas, Bykov
Exams					
SS 2019	76-T-MACH-105331	Laboratory Exercise in Energy Technology		Prüfung (PR)	Bauer, Maas, Wirbser

Competence Certificate
1 report, approx. 12 pages

Discussion of the documented results with the assistents

Prerequisites
none

Below you will find excerpts from events related to this course:

V Laboratory Exercise in Energy Technology

2171487, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heatpump
- Plant oil stove
- Heat capacity
- Wood combustion

Annotation
Online registration within the first two weeks of the lecture periode at: http://www.its.kit.edu

Workload
regular attendance: 42h
self-study: 78h

V **Laboratory Exercise in Energy Technology** **Practical course (P)**
2171487, WS 19/20, 3 SWS, Language: German, Open in study portal

Learning Content

- Micro gas turbine
- Several test rigs for the investigation of heat transfer at thermally high loaded components
- Optimization of components of the internal air and oil system
- Characterization of spray nozzles
- Investigation of pollutant and noise emission as well as reliability and material deterioration
- Exhaust gas treatment
- Exhaust gas turbocharger
- Cooling Tower
- Heatpump
- Plant oil stove
- Heat capacity
- Wood combustion

Annotation
Online registration within the first two weeks of the lecture periode at: http://www.its.kit.edu

Workload
regular attendance: 42h
self-study: 78h

T 3.180 Course: Laboratory Laser Materials Processing [T-MACH-102154]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	2

Events					
SS 2019	2183640	Laboratory "Laser Materials Processing"	3 SWS	Practical course (P)	Schneider, Pfleging
WS 19/20	2183640	Laboratory "Laser Materials Processing"	3 SWS	Practical course (P)	Schneider, Pfleging
Exams					
SS 2019	76-T-MACH-102154	Laboratory Laser Materials Processing		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-102154	Laboratory Laser Materials Processing		Prüfung (PR)	Schneider

Competence Certificate
The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Prerequisites
none

Recommendation
basic knowledge of physics, chemistry and material science

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

Annotation
The maximum number of students is 12 per semester.

Below you will find excerpts from events related to this course:

V Laboratory "Laser Materials Processing"
2183640, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

lecture notes via ILIAS

Notes
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Learning Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

Annotation
The maximum number of students is 12 per semester.

Workload
regular attendance: 34 hours
self-study: 86 hours

Literature
W.T. Silfvast: Laser Fundamentals, 2008, Cambrigde University Press

W.M. Steen: Laser Materials Processing, 2010, Springer

V **Laboratory "Laser Materials Processing"** **Practical course (P)**
2183640, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

lecture notes via ILIAS

Notes
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

The student

- can describe the influence of laser, material and process parameters and can choose suitable parameters for the most important methods of laser-based processing in automotive engineering.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

The attendance to one of the courses Physical Basics of Laser Technology (2181612) or Laser Application in Automotive Engineering (2182642) is strongly recommended.

regular attendance: 34 hours
self-study: 86 hours

The assessment consists of a colloquium for every single experiment and an overall final colloquium incl. an oral presentation of 20 min.

Learning Content
The laboratory compromises 8 half-day experiments, which address the following laser processing topics of metals, ceramics and polymers:

• safety aspects

• surface hardening and remelting

• melt and reactive cutting

• surface modification by dispersing or alloying

• welding

• surface texturing

• metrology

There are used CO2-, excimer-, Nd:YAG- and high power diode-laser sources within the laboratory.

Annotation
The maximum number of students is 12 per semester.

Workload
regular attendance: 34 hours
self-study: 86 hours

Literature
W.T. Silfvast: Laser Fundamentals, 2008, Cambrigde University Press

W.M. Steen: Laser Materials Processing, 2010, Springer

T 3.181 Course: Laboratory Mechatronics [T-MACH-105370]

Responsible: Dr.-Ing. Maik Lorch
Prof. Dr.-Ing. Wolfgang Seemann
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	4

Events					
WS 19/20	2105014	Laboratory mechatronics	3 SWS	Practical course (P)	Seemann, Stiller, Lorch, Böhland, Burgert

Competence Certificate
certificate of successful attendance

Prerequisites
None

Below you will find excerpts from events related to this course:

V Laboratory mechatronics

2105014, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes
Part I
Control, programming and simulation of robots
CAN-Bus communication
Image processing / machine vision
Dynamic simulation of robots in ADAMS

Part II
Solution of a complex problem in team work

Learning objectives:

The student is able to ...

- use his knowledge about mechatronics and microsystems technology to solve a practical problem. The laboratory course comprises simulation, bus communication, measurement instrumentation, control engineering and programming.
- integrate the different subsystems from a manipulator to a working compound system in teamwork.

Learning Content
Part I
Control, programming and simulation of robots
CAN-Bus communication
Image processing / machine vision
Dynamic simulation of robots in ADAMS

Part II
Solution of a complex problem in team work

Workload
regular attendance: 33.5 h
self-study: 88.5 h

Literature
Manuals for the laboratory course on Mechatronics

T 3.182 Course: Laser in Automotive Engineering [T-MACH-105164]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2182642	Laser in automotive engineering	2 SWS	Lecture (V)	Schneider
Exams					
SS 2019	76-T-MACH-105164	Laser in Automotive Engineering		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-105164	Laser in Automotive Engineering		Prüfung (PR)	Schneider

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102102 - Physical Basics of Laser Technology must not have been started.

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Below you will find excerpts from events related to this course:

V Laser in automotive engineering
2182642, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

lecture notes via ILIAS

Notes
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- savety aspects

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of Nd:YAG-, CO2- and high power diode-laser sources.
- can describe the most important methods of laser-based processing in automotive engineering and illustrate the influence of laser, material and process parameters
- can analyse manufacturing problems and is able to choose a suitable laser source and process parameters.
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

It is not possible, to combine this lecture with the lecture *Physical basics of laser technology* [2181612].

regular attendance: 22,5 hours
self-study: 97,5 hours

oral examination (ca. 30 min)

no tools or reference materials

Learning Content
Based on a short description of the physical basics of laser technology the lecture reviews the most important high power lasers and their various applications in automotive engineering. Furthermore the application of laser light in metrology and safety aspects will be addressed.

- physical basics of laser technology
- laser beam sources (Nd:YAG-, CO2-, high power diode-laser)
- beam properties, guiding and shaping
- basics of materials processing with lasers
- laser applications in automotive engineering
- economical aspects
- savety aspects

Annotation
It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
W. M. Steen: Laser Material Processing, 2010, Springer

W. T. Silfvast: Laser Fundamentals, 2008, Cambridge University Press

T 3.183 Course: Leadership and Conflict Management [T-MACH-105440]

Responsible: Hans Hatzl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2110017	Leadership and Conflict Management (in German)	2 SWS	Lecture (V)	Hatzl
Exams					
SS 2019	76-T-MACH-105440	Leadership and Conflict Management		Prüfung (PR)	Deml

Competence Certificate
oral exam (approx. 30 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Leadership and Conflict Management (in German)

2110017, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

1. Introduction to the course
2. Goal definition and goal achievement
3. Management techniques within planning
4. Communication and information
5. Decision-making
6. Leadership and co-operation
7. Self management
8. Conflict management
9. Case studies

Requirements:

- Compact course
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge of Work Science and Economics is helpful

Learning objective:

- Knowledge of techniques for management and leadership
- Preparation for management and leadership tasks in the job

Learning Content

1. Introduction to the course
2. Goal definition and goal achievement
3. Management techniques within planning
4. Communication and information
5. Decision-making
6. Leadership and co-operation
7. Self management
8. Conflict management
9. Case studies

Workload
The amount of work accounts for 120 h (=4 ECTS).

Literature
Handout and literature are available on ILIAS for download.

T 3.184 Course: Leadership and Management Development [T-MACH-105231]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Andreas Ploch

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2145184	Leadership and Product Development	2 SWS	Lecture (V)	Ploch

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Leadership and Product Development

2145184, WS 19/20, 2 SWS, Open in study portal

Lecture (V)

Learning Content
Leadership theories

Management tools

Communication as management tool

Change management

Management development and MD-Programs

Assessment center and management audits

Team work, team development und team roles

Intercultural competences

Leadership and ethics, Corporate Governance

Executive Coaching

Lectures of industrial experts

Workload
regular attendance: 21 h

self-study: 99 h

T 3.185 Course: Lightweight Engineering Design [T-MACH-105221]

Responsible: Prof. Dr.-Ing. Albert Albers
Norbert Burkardt

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2146190	Lightweight Engineering Design	2 SWS	Lecture (V)	Albers, Burkardt
Exams					
SS 2019	76-T-MACH-105221	Lightweight Engineering Design		Prüfung (PR)	Albers, Burkardt

Competence Certificate
Written examination (90 min)

Prerequisites
None

Below you will find excerpts from events related to this course:

V Lightweight Engineering Design
2146190, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
General aspects of leightweight design, lightweight strategies, construction methods, design principles, lightweight construction, stiffening techniques, lightweight materials, virtual product engineering, bionics, joining techniques, validation, recycling

Additionally, guest speakers from industry will present lightweight design from an practical point of view.

The students are able to ...

- evaluate the potential of central lightweight strategies and their application in design processes.
- apply different stiffing methods qualitatively and to evaluate their effectiveness.
- evaluate the potential of computer-aided engineering as well as the related limits and influences on manufacturing.
- reflect the basics of lightweight construction from a system view in the context of the product engineering process.

T 3.186 Course: Localization of Mobile Agents [T-INFO-101377]

Responsible: Prof. Dr.-Ing. Uwe Hanebeck
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	24613	Localization of Mobile Agents	3 SWS	Lecture (V)	Noack, Li
Exams					
SS 2019	7500004	Localization of Mobile Agents		Prüfung (PR)	Hanebeck, Noack
WS 19/20	7500020	Localization of Mobile Agents		Prüfung (PR)	Noack, Hanebeck

Below you will find excerpts from events related to this course:

V Localization of Mobile Agents

24613, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
This module provides a systematic introduction into the topic of localization methods. In order to facilitate understanding, the module is divided into four main topics. Dead reckoning treats the instantaneous determination of a vehicle's position based on dynamic parameters like velocity or steering angle. Localization with the help of measurements of known landmarks is part of static localization. In addition to the closed-form solutions for particular measurements (distances and angles), the least squares method for fusion arbitrary measurements is also introduced. Dynamic localization treats the combination of dead reckoning and static localization. The central part of the lecture is the derivation of the Kalman filter, which has been successfully applied in several practical applications. Finally, simultaneous localization and mapping (SLAM) is introduced, which allows localization in case of (partly) unknown landmark positions.

Workload
The amount of work required is ca.180 hours.

T 3.187 Course: Logistics - Organisation, Design and Control of Logistic Systems [T-MACH-102089]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2118078	Logistics - Organisation, Design, and Control of Logistic Systems	3 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-102089	Logistics - Organisation, Design and Control of Logistic Systems		Prüfung (PR)	Furmans, Mittwollen

Competence Certificate
The assessment consists of a 90 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
None

Recommendation
Requied are lectures on "Linear Algebra" and "Stochastic".

Below you will find excerpts from events related to this course:

V Logistics - Organisation, Design, and Control of Logistic Systems
Lecture (V)
2118078, SS 2019, 3 SWS, Language: German, Open in study portal

Description
Media:

Blackboard, LCD projector, in excercises also PCs.

Learning Content
Introduction

- historical overview
- lines of development

Structure of logistics systems
Distribution logistics

- location planning
- Vehicle Routing Planning
- distribution centers

Inventory management

- demand forecasting
- Inventory management policies
- Bullwhip effect

Production logistics

- layout planning
- material handling
- flow control

Supply Managament

- information flow
- transportation organization
- controlling and development of a logistics system
- co-operation mechanisms
- Lean SCM
- SCOR model

Identification Technologies

Workload
180 hrs

Literature

- Arnold/Isermann/Kuhn/Tempelmeier. Handbuch Logistik, Springer Verlag, 2002 (Neuauflage in Arbeit)
- Domschke. Logistik, Rundreisen und Touren, Oldenbourg Verlag, 1982
- Domschke/Drexl. Logistik, Standorte, Oldenbourg Verlag, 1996
- Gudehus. Logistik, Springer Verlag, 2007
- Neumann-Morlock. Operations-Research, Hanser-Verlag, 1993
- Tempelmeier. Bestandsmanagement in Supply Chains, Books on Demand 2006
- Schönsleben. Integrales Logistikmanagement, Springer, 1998

T 3.188 Course: Logistics and Supply Chain Management [T-WIWI-102870]

Responsible: Dr. Marcus Wiens
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	3,5	Each summer term	1

Events					
SS 2019	2581996	Logistics and Supply Chain Management	2 SWS	Lecture (V)	Wiens
SS 2019	2581997	Übung zu Logistics and Supply Chain Management	1 SWS	Practice (Ü)	Diehlmann, Lüttenberg
Exams					
SS 2019	7981996	Logistics and Supply Chain Management		Prüfung (PR)	Schultmann

Competence Certificate
The assessment consists of an oral (30 minutes) or a written (60 minutes) exam (following §4(2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Logistics and Supply Chain Management

2581996, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content

- Introduction: Basic Terms and Concepts
- Logistics Systems and Supply Chain Management
- Supply Chain Risk Management
- Extensions and Applications

Workload
Toatl effort required will account for approximately 105h (3.5 credits).

Literature
will be announced in the course

T 3.189 Course: Machine Dynamics [T-MACH-105210]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	1

Events					
SS 2019	2161224	Machine Dynamics	2 SWS	Lecture (V)	Proppe
SS 2019	2161225	Machine Dynamics (Tutorial)	1 SWS	Practice (Ü)	Proppe, Koebele
Exams					
SS 2019	76-T-MACH-105210	Machine Dynamics		Prüfung (PR)	Proppe

Competence Certificate
written exam, 180 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Machine Dynamics

2161224, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
1. Introduction

2. Machine as mechatronic system
3. Rigid rotors: equations of motion, transient and stationary motion, balancing
4. Flexible rotors: Laval rotor (equations of motion, transient and stationary behavior, critical speed, secondary effects), refined models)
5. Slider-crank mechanisms: kinematics, equations of motion, mass and power balancing

Workload
Lectures and exercices: 32 h

Studies: 118 h

Literature
Biezeno, Grammel: Technische Dynamik, 2. Edition, 1953

Holzweißig, Dresig: Lehrbuch der Maschinendynamik, 1979

Dresig, Vulfson: Dynamik der Mechanismen, 1989

V Machine Dynamics (Tutorial)

2161225, SS 2019, 1 SWS, Language: English, Open in study portal

Practice (Ü)

Learning Content
Excercises related to the lecture

T 3.190 Course: Machine Dynamics II [T-MACH-105224]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2162220	Machine Dynamics II	2 SWS	Lecture (V)	Proppe

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Machine Dynamics

Below you will find excerpts from events related to this course:

V Machine Dynamics II — Lecture (V)
2162220, WS 19/20, 2 SWS, Language: English, Open in study portal

Learning Content
- hydrodynamic bearings
- rotating shafts in hydrodynamic bearings
- belt drives
- virbation of turbine blades

Workload
Lectures: 20 h
Self-studies: 100 h

Literature
R. Gasch, R. Nordmann, H. Pfützner: Rotordynamik, Springer, 2006

T 3.191 Course: Machine Tools and Industrial Handling [T-MACH-109055]

Responsible: Prof. Dr.-Ing. Jürgen Fleischer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	1

Events					
WS 19/20	2149902	Machine Tools and Industrial Handling	6 SWS	Lecture / Practice (VÜ)	Fleischer
Exams					
SS 2019	76-T-MACH-109055	Machine Tools and Industrial Handling		Prüfung (PR)	Fleischer

Competence Certificate
Oral exam (40 minutes)

Prerequisites
"T-MACH-102158 - Werkzeugmaschinen und Handhabungstechnik" must not be commenced.

Below you will find excerpts from events related to this course:

V Machine Tools and Industrial Handling
2149902, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

The lecture gives an overview of the construction, use and application of machine tools and industrial handling equipment. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools is conveyed. First, the main components of the machine tools are systematically explained and their design principles as well as the integral machine tool design are discussed. Subsequently, the use and application of machine tools will be demonstrated using typical machine examples. Based on examples from current research and industrial applications, the latest developments are discussed, especially concerning the implementation of Industry 4.0.

The individual topics are:

- Frames and frame components
- Feed axes
- Spindles
- Peripheral equipment
- Control unit
- Metrological evaluation and machine testing
- Process monitoring
- Maintenance of machine tools
- Safety assessment of machine tools
- Machine examples

Learning Outcomes:

The students ...

- are able to assess the use and application of machine tools and handling equipment and to differentiate between them in terms of their characteristics and design.
- can describe and discuss the essential elements of the machine tool (frame, main spindle, feed axes, peripheral equipment, control unit).
- are able to select and dimension the essential components of a machine tool.
- are capable of selecting and evaluating machine tools according to technical and economic criteria.

Workload:

MACH:
regular attendance: 63 hours
self-study: 177 hours
WING:
regular attendance: 63 hours
self-study: 207 hours

Learning Content

The lecture gives an overview of the construction, use and application of machine tools and industrial handling equipment. In the course of the lecture a well-founded and practice-oriented knowledge for the selection, design and evaluation of machine tools is conveyed. First, the main components of the machine tools are systematically explained and their design principles as well as the integral machine tool design are discussed. Subsequently, the use and application of machine tools will be demonstrated using typical machine examples. Based on examples from current research and industrial applications, the latest developments are discussed, especially concerning the implementation of Industry 4.0.

The individual topics are:

- Frames and frame components
- Feed axes
- Spindles
- Peripheral equipment
- Control unit
- Metrological evaluation and machine testing
- Process monitoring
- Maintenance of machine tools
- Safety assessment of machine tools
- Machine examples

Annotation

None

Workload
MACH:
regular attendance: 63 hours
self-study: 177 hours
WiIng:/TVWL
regular attendance: 63 hours
self-study: 207 hours

T 3.192 Course: Machine Vision [T-MACH-105223]

Responsible: Dr. Martin Lauer
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	8	Each winter term	2

Events					
WS 19/20	2137308	Machine Vision	4 SWS	Lecture / Practice (VÜ)	Lauer, Quehl
Exams					
SS 2019	76-T-MACH-105223	Machine Vision		Prüfung (PR)	Stiller, Lauer

Competence Certificate
Type of Examination: written exam

Duration of Examination: 60 minutes

Prerequisites
None

Below you will find excerpts from events related to this course:

V Machine Vision
2137308, WS 19/20, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)

Notes
Lernziele (EN):

Machine vision (or *computer vision*) describes all kind of techniques that can be used to extract information from camera images in an automated way. Considerable improvements of machine vision techniques throughout recent years, e.g. by the advent of deep learning, have caused growing interest in these techniques and enabled applications in various domains, e.g. robotics, autonomous driving, gaming, production control, visual inspection, medicine, surveillance systems, and augmented reality.

The participants should gain an overview over the basic techniques in machine vision and obtain hands-on experience.

Learning Content
The lecture on machine vision covers basic techniques of machine vision. It focuses on the following topics:

image preprocessing

edge and corner detection

curve and parameter fitting

color processing

image segmentation

camera optics

pattern recognition

deep learning

Image preprocessing:

The chapter on image processing discusses techniques and algorithms to filter and enhance the image quality. Starting from an analysis of the typical phenomena of digital camera based image capturing the lecture introduces the Fourier transform and the Shannon-Nyquist sampling theorem. Furthermore, it introduces gray level histogram based techniques including high dynamic range imaging. The disussion of image convolution and typical filters for image enhancement concludes the chapter.

Edge and corner detection:

Gray level edges and gray level corners play an important role in machine vision since gray level edges often reveal valueable information about the boundaries and shape of objects. Gray level corners can be used as feature points since they can be identified easily in other images. This chapter introduces filters and algorithms to reveal gray level edges and gray level corners like the Canny edge detector and the Harris corner detector.

Curve and parameter fitting:

In order to describe an image by means of geometric primitives (e.g. lines, circles, ellipses) instead of just pixels robust curve and parameter fitting algorithms are necessary. The lecture introduces and discusses the Hough transform, total least sum of squares parameter fitting as well as robust alternatives (M-estimators, least trimmed sum of squares, RANSAC)

Color processing:

The short chapter on color processing discusses the role of color information in machine vision and introduces various models for color understanding and color representation. It concludes with the topic of color consistency.

Image Segmentation:

Image segmentation belongs to the core techniques of machine vision. The goal of image segmentation is to subdivide the image into several areas. Each area shares common properties, i.e. similar color, similar hatching, or similar semantic interpretation. Various ideas for image segmentation exist which can be used to create more or less complex algorithms. The lecture introduces the most important approaches ranging from the simpler algorithms like region growing, connected components labeling, and morphological operations up to highly flexible and powerful methods like level set approaches and random fields.

Camera optics:

The content of an image is related by the optics of the camera to the 3-dimensional world. In this chapter the lecture introduces optical models that describe the relationship between the world and the image including the pinhole camera model, the thin lens model, telecentric cameras, and catadioptric sensors. Furthermore, the lecture introduces camera calibration methods that can be used to determine the optical mapping of a real camera.

Pattern recognition:

Pattern recognition aims at recognizing semantic information in an image, i.e. not just analyzing gray values or colors of pixels but revealing which kind of object is shown by the pixels. This task goes beyond classical measurement theory and enters the large field of artificial intelligence. Rather than just being developped and optimized by a programmer, the algorithms are adapting themselves to their specific task using training algorithms that are based on large collections of sample images.

The chapter of pattern recognition introduces standard techniques of pattern recognition in the context of image understanding like the support vector machine (SVM), decision trees, ensemble and boosting techniques. It combines those classifiers with powerful feature representation techniques like the histogram of oriented gradients (HOG) features, locally binary patterns (LBP), and Haar features.

Deep learning:

Throughout recent years standard pattern recognition technqiues have more and more been outperformed by deep learning techniques. Deep learning is based on artificial neural networks, a very generic and powerful form of a classifier. The lecture introduces multi layer perceptrons as the most relevant form of artificial neural networks, discusses training algorithms and strategies to achieve powerful classifiers based on deep learning including deep auto encoders, convolutional networks, and multi task learning, among others.

Workload
240 hours

Literature
Main results are summarized in the slides that are made available as pdf-files. Further recommendations will be presented in the lecture.

T 3.193 Course: Magnet Technology of Fusion Reactors [T-MACH-105434]

Responsible: Dr. Walter Fietz
Dr. Klaus-Peter Weiss

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering
M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190496	Magnet Technology of Fusion Reactors	2 SWS	Lecture (V)	Fietz, Weiss
Exams					
SS 2019	76-T-MACH-105434	Magnet Technology of Fusion Reactors		Prüfung (PR)	Fietz, Weiss, Stieglitz
WS 19/20	76-T-MACH-105434	Magnet Technology of Fusion Reactors		Prüfung (PR)	Cheng

Competence Certificate
Oral examination of about 30 minutes

Prerequisites
none

Annotation
none

Below you will find excerpts from events related to this course:

V Magnet Technology of Fusion Reactors

Lecture (V)

2190496, SS 2019, 2 SWS, Language: German/English, Open in study portal

Notes

In Greifswald/Germany the fusion experiment Wendelstein 7-X is now in operation to demonstrate the performance of Stellerator-type fusion machines. In south of France the fusion reactor ITER is under construction which will demonstrate the production of energy by fusion. In both machines the plasma inclusion will be ensured by magnets and to produce high magnetic fields in an efficient way, these magnets have to be superconducting. Design, construction and operation of such magnets is a technologic challenge because low temperature (4.5 K) and high currents (typ. 68 kA) are necessary.

The lecture will show basic principles for design and construction of such magnets and includes:

- Introduction with examples to nuclear fusion and to magnetic plasma confinement
- Basics of low temperature and high temperature properties and cryotechnique
- Material testing and critical material properties at low temperatures
- Principles of magnet design, construction and safe magnet operation
- Present status and magnet examples from fusion projects ITER, W7-X and JT-60SA
- Application of high temperature superconductors on fusion and power engineering

The goal of the lecture is to impart the fundamentals of construction of superconducting magnets. Magnet technology is inherently of multidisciplinary character e.g. material properties at low temperature, high voltage and high current technique. The use of superconductors is mandatory to reach highest magnetic fields with comparable small losses. Examples of magnets from power application, basic research and fusion reactor construction are discussed.

Lecture Content:

- Basics of nuclear fusion and design aspects of fusion magnets
- Superconductors - basics and stability
- Low temperature cryogenic aspects
- Low temperature and high temperature superconductors
- Cryogenic material testing and properties of fusion materials at low temperatures
- Quench and high voltage aspects for magnets
- Status and magnets of fusion machines ITER, W7-X, JT-60SA & future DEMO
- Impact of high temperature superconductors on fusion and power engineering

Educational objective: The students know:

- Magnetic plasma confinement principles in connection with fusion machine
- Examples and basic properties of different superconductors
- Basics of formation of superconducting cables and magnet construction
- Generation of low temperature, cryostat construction
- Basics of magnet design and magnet safety
- Material testing and material properties at low temperatures
- High-temperature superconductor use in magnet construction and power application

Recommendations:

Knowledge in energy technology, power plants, material testing is welcomed

- Time of attendance: 2 SWS, Other: excursion, etc. 5 hours
- Self-study: preparation and postprocessing LV (course): 1 hour / week
- Preparation for the examination: 80 hours per semester

Oral examination of about 30 minutes

Learning Content

The goal of the lecture is to impart the fundamentals of construction of superconducting magnets. Magnet technology is inherently of multidisciplinary character e.g. material properties at low temperature, high voltage and high current technique. The use of superconductors is mandatory to reach highest magnetic fields with comparable small losses. Examples of magnets from power application, basic research and fusion reactor construction are discussed.

Lecture Content:

- Introduction to plasma, fusion and electromagnets
- Introduction superconductivity - basics and materials
- Creation of low temperatures, cryo-technique
- Material properties at low temperature
- Magnet design and calculation
- Magnet stability, quench safety and high voltage protection
- Magnet examples
- High-temperature superconductors (HTS)
- HTS-application (cable, motor/generator, FCL, current leads, fusion reactors)

Workload
- Time of attendance: 2 SWS, Other: excursion, etc. 5 hours
- Self-study: preparation and postprocessing LV (course): 1 hour / week
- Preparation for the examination: 80 hours per semester

T 3.194 Course: Magnetohydrodynamics [T-MACH-105426]

Responsible: Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153429	Magnetohydrodynamics	2 SWS	Lecture (V)	Bühler

Competence Certificate
oral

Duration: 30 minutes

No auxiliary means

Prerequisites
The partial performance number T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) must not be startet or completed.

The partial services T-MACH-108845 "Magnetohydrodynamics" (Nat/Inf/Etit) and T-MACH-105426 "Magnetohydrodynamics" are mutually exclusive.

Recommendation
Fluid Mechanics (T-MACH-105207)

Mathematical Methods in Fluid Mechanics (T-MACH-105295)

Below you will find excerpts from events related to this course:

V Magnetohydrodynamics

2153429, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfven waves
- Stability, transition to turbulence
- Liquid dynamos

Educational objective: The students can describe the fundamentals of magnetohydrodynamics. They are qualified to explain the interrelations of electro and fluid dynamics so as to analyze magnetohydrodynamic flows in engineering applications or for phenomena in geo and astrophysics.

Learning Content

- Introduction
- Basics of electro and fluid dynamics
- Exact solutions, Hartmann flow, pump, generator, channel flows
- Inductionless approximation
- Developing flows, change of cross-section, variable magnetic fields
- Alfven waves
- Stability, transition to turbulence
- Liquid dynamos

Annotation
Recommendation: Fluid Mechanics

Workload
regular attendance: 21 hours

self-study: 90 hours

Literature
U. Müller, L. Bühler,2001,Magnetofluiddynamics in Channels and Containers, ISBN 3-540-41253-0, Springer

R. Moreau, 1990, Magnetohydrodynamics, Kluwer Academic Publisher

P. A. Davidson, 2001, An Introduction to Magnetohydrodynamics, Cambridge University Press

J. A. Shercliff, 1965, A Textbook of Magnetohydrodynamics, Pergamon Press

T 3.195 Course: Management Accounting 1 [T-WIWI-102800]

Responsible: Prof. Dr. Marcus Wouters
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	4,5	Each summer term	2

Events					
SS 2019	2579900	Management Accounting 1	2 SWS	Lecture (V)	Wouters
SS 2019	2579901	Übung zu Management Accounting 1	2 SWS	Practice (Ü)	Riar
Exams					
SS 2019	79-2579900-00	Management Accounting 1		Prüfung (PR)	Wouters
WS 19/20	79-2579900-00	Management Accounting 1		Prüfung (PR)	Wouters

Competence Certificate
The assessment consists of a written exam (120 minutes) (following §4(2), 1 of the examination regulation) at the end of each semester.

Prerequisites
None

Annotation
Students in the Bachelor' program can only take the related tutorial and examination. Students in the Master's program (and Bachelor's students who are already completing examinations for their Master's program) can only take the related tuturial and examination.

Below you will find excerpts from events related to this course:

V Management Accounting 1
2579900, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
see Module Handbook

Learning Content
The course covers topics in management accounting in a decision-making framework. Some of these topics in the course MA1 are: short-term planning, investment decisions, budgeting and activity-based costing.

We will use international material written in English.

We will approach these topics primarily from the perspective of the users of financial information (not so much from the controller who prepares the information).

The course builds on an introductory level of understanding of accounting concepts from Business Administration courses in the core program. The course is intended for students in Industrial Engineering.

Workload
The total workload for this course is approximately 135.0 hours. For further information see German version.

Literature

- Marc Wouters, Frank H. Selto, Ronald W. Hilton, Michael W. Maher: Cost Management – Strategies for Business Decisions, 2012, Publisher: McGraw-Hill Higher Education (ISBN-13 9780077132392 / ISBN-10 0077132394)
- In addition, several papers that will be available on ILIAS.

V **Übung zu Management Accounting 1** **Practice (Ü)**
2579901, SS 2019, 2 SWS, Language: English, Open in study portal

Notes
see Module Handbook

T 3.196 Course: Management and Strategy [T-WIWI-102629]

Responsible: Prof. Dr. Hagen Lindstädt
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	3,5	Each summer term	1

Events					
SS 2019	2577900	Management and Strategy	2 SWS	Lecture (V)	Lindstädt
Exams					
SS 2019	7900067	Management and Strategy		Prüfung (PR)	Lindstädt

Competence Certificate
The assessment consists of a written exam (60 min) taking place at the beginn of the recess period (according to §4 (2), 1 of the examination regulation). The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Management and Strategy
2577900, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description

- Corporate management principles
- Strategic management principles
- Strategic analysis
- Competitive strategy: modelling and selection on a divisional level
- Strategies for oligopolies and networks: anticipation of dependencies
- Corporate strategy: modelling and evaluation on a corporate level
- Strategy implementation

Learning Content
The participants learn about central concepts of strategic management along the ideal-typical strategy process: internal and external strategic analysis, concept and sources of competitive advantages, their importance when establishing competitive and corporate strategies as well as strategy assessment and implementation. This aims in particular to provide a summary of the basic concepts and models of strategic management, i.e. to provide in particular an action-oriented integration. Thereby a focus is on imparting knowledge about how price developments in oligopolistic markets can be understood, modeled and forecasted based on game theory.

Annotation
The credits for the course "Management and Strategy" have been changed from 4 to 3,5 from summer term 2015 on.

Workload
The total workload for this course is approximately 105.0 hours. For further information see German version.

Literature

- Grant, R.M.: *Contemporary Strategy Analysis.* Blackwell, 5. Aufl. Massachusetts 2005.
- Lindstädt, H.; Hauser, R.: *Strategische Wirkungsbereiche von Unternehmen.* Gabler, Wiesbaden 2004.

The relevant excerpts and additional sources are made known during the course.

T 3.197 Course: Manufacturing Technology [T-MACH-102105]

Responsible: Prof. Dr.-Ing. Volker Schulze
Dr.-Ing. Frederik Zanger

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	8	Each winter term	3

Events					
WS 19/20	2149657	Manufacturing Technology	6 SWS	Lecture / Practice (VÜ)	Schulze, Zanger
Exams					
SS 2019	76-T-MACH-102105	Manufacturing Technology		Prüfung (PR)	Schulze

Competence Certificate
Written Exam (180 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Manufacturing Technology

2149657, WS 19/20, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:
Lecture notes will be provided in ilias (https://ilias.studium.kit.edu/).

Notes

The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lucture provides an excursion to an industry company.

Learning Outcomes:

The students ...

- are capable to specify the different manufacturing processes and to explain their functions.
- are able to classify the manufacturing processes by their general structure and functionality according to the specific main groups.
- have the ability to perform a process selection based on their specific characteristics.
- are enabled to identify correlations between different processes and to select a process regarding possible applications.
- are qualified to evaluate different processes regarding specific applications based on technical and economic aspects.
- are experienced to classify manufacturing processes in a process chain and to evaluate their specific influence on surface integrity of workpieces regarding the entire process chain.

Workload:

regular attendance: 63 hours
self-study: 177 hours

Learning Content

The objective of the lecture is to look at manufacturing technology within the wider context of production engineering, to provide an overview of the different manufacturing processes and to impart detailed process knowledge of the common processes. The lecture covers the basic principles of manufacturing technology and deals with the manufacturing processes according to their classification into main groups regarding technical and economic aspects. The lecture is completed with topics such as process chains in manufacturing.

The following topics will be covered:

- Quality control
- Primary processing (casting, plastics engineering, sintering, additive manufacturing processes)
- Forming (sheet-metal forming, massive forming, plastics engineering)
- Cutting (machining with geometrically defined and geometrically undefined cutting edges, separating, abrading)
- Joining
- Coating
- Heat treatment and surface treatment
- Process chains in manufacturing

This lucture provides an excursion to an industry company.

Annotation

None

Workload

regular attendance: 63 hours
self-study: 177 hours

Literature

Lecture Notes

T 3.198 Course: Material Flow in Logistic Systems [T-MACH-102151]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Examination of another type	9	Each winter term	3

Events					
WS 19/20	2117051	Material flow in logistic systems	6 SWS	Others (sonst.)	Furmans
Exams					
SS 2019	76-T-MACH-102151	Material Flow in Logistic Systems		Prüfung (PR)	Furmans

Competence Certificate
The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
    - 40% assessment of the result of the case studies as group work,
    - 20% assessment of the oral examination during the case study colloquiums as individual performance.

A detailed description of the learning control can be found under Annotations.

Prerequisites
none

Recommendation
Recommended elective subject: Probability Theory and Statistics

Annotation
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. In the oral examination during the case study colloquiums, the understanding of the result of the group work and the models dealt with in the course is tested. The participation in the oral defenses is compulsory and will be controlled. For the written submission the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

Below you will find excerpts from events related to this course:

V Material flow in logistic systems
Others (sonst.)

2117051, WS 19/20, 6 SWS, Language: German, Open in study portal

Description
Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

Media: Presentations, black board, book, video recordings

Notes
Learning Content:

- Elements of material flow systems (conveyor elements, fork, join elements)
- Models of material flow networks using graph theory and matrices
- Queueing theory, calculation of waiting time, utilization
- Warehouseing and order-picking
- Shuttle systems
- Sorting systems
- Simulation
- Calculation of availability and reliability
- Value stream analysis

After successful completion of the course, you are able (alone and in a team) to:

- Accurately describe a material handling system in a conversation with an expert.
- Model and parameterize the system load and the typical design elements of a material handling system.
- Design a material handling system for a task.
- Assess the performance of a material handling system in terms of the requirements.
- Change the main lever for influencing the performance.
- Expand the boundaries of today's methods and system components conceptually if necessary.

Literature:

Arnold, Dieter; Furmans, Kai: Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 2009

Description:

Students are divided into groups for this course. Five case studies are carried out in these groups. The results of the group work during the lecture period are presented and evaluated in writing. During the colloquiums, the result of the case study is presented and the understanding of the group work and the models dealt with in the course are tested in an oral defense. The participation in the colloquiums is compulsory and will be controlled. For the written submission and the presentation the group receives a common grade, in the oral defense each group member is evaluated individually.

After the lecture period, there is the final case study. This case study contains the curriculum of the whole semester. The students work individually on this case study which takes place at a predefined place and time (duration: 4h).

We strongly recommend to attend the introductory session at 16.10.2019. In this session, the teaching concept of "Materialfluss in Logistiksysteme" is explained and outstanding issues are clarified.

Workload:

- Regular attendance: 35 h
- Self-study: 135 h
- Group work: 100 h

Competence Certificate:

The assessment (Prüfungsleistung anderer Art) consists of the following assignments:

- 40% assessment of the final case study as individual performance,
- 60% semester evaluation which includes working on 5 case studies and defending those (For both assessment types, the best 4 of 5 tries count for the final grade.):
    - 40% assessment of the result and the presentation of the case studies as group work,
    - 20% assessment of the oral examination during the colloquiums as individual performance.

Learning Content

- Elements of material flow systems (conveyor elements, fork, join elements)
- Models of material flow networks using graph theory and matrices
- Queueing theory, calculation of waiting time, utilization
- Warehouseing and order-picking
- Shuttle systems
- Sorting systems
- Simulation
- Calculation of availability and reliability
- Value stream analysis

Annotation
none

Workload

Regular attendance: 35 h

Self-study: 135 h

Group work: 100 h

Literature

Arnold, Dieter; Furmans, Kai : Materialfluss in Logistiksystemen; Springer-Verlag Berlin Heidelberg, 2009

T 3.199 Course: Materials Characterization [T-MACH-107684]

Responsible: Dr.-Ing. Jens Gibmeier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	3

Events					
WS 19/20	2174586	materials characterization	2 SWS	Lecture (V)	Schneider, Gibmeier
Exams					
SS 2019	76-T-MACH-107684	Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier
WS 19/20	76-T-MACH-107684	Materials Characterization		Prüfung (PR)	Heilmaier, Gibmeier

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
Successful participation in Exercises for Materials Characterization is the condition for the admittance to the oral exam in Materials Characterization.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.

Below you will find excerpts from events related to this course:

V materials characterization
Lecture (V)

2174586, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

learning objectives:
The students have fundamental knowledge about methods of material analysis. They have a basic understanding to transfer this fundamental knowledge on problems in engineering science. Furthermore, the students have the ability to describe technical material by its microscopic and submicroscopic structure.
requirements:
none
workload:

The workload for the module “Materials Characterization” is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Learning Content
The following methods will be introduced within this lecture:

- microscopic methods: optical microscopy, electron microscopy (SEM/TEM), atomic force microscopy
- material and microstructure analyses by means of X-ray, neutron and electron beams
- analysis methods at SEM/TEM (e.g. EELS)
- spectroscopic methods (e.g. EDS / WDS)

Workload
The workload for the module “Materials Characterization” is 180 h per semester and consists of the presence during the lectures (21 h) and tutorials (12 h) as well as self-study for the lecture (99 h) and for the tutorials (48 h).

Literature
Lecture notes (will be provided at the beginning of the lecture).

Literature will be announced at the beginning of the lecture.

T 3.200 Course: Materials Modelling: Dislocation Based Plasticy [T-MACH-105369]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2182740	Materials modelling: dislocation based plasticy	2 SWS	Lecture (V)	Weygand
Exams					
SS 2019	76-T-MACH-105369	Materials Modelling: Dislocation Based Plasticy		Prüfung (PR)	Weygand

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Below you will find excerpts from events related to this course:

V Materials modelling: dislocation based plasticy — Lecture (V)
2182740, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
a) fcc
b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

The student

- has the basic understanding of the physical basics to describe dislocations and their interaction with point, line and area defects.
- can apply modelling approaches for dislocation based plasticity.
- can explain discrete methods for modelling of microstructural evolution processes.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Learning Content
1. Introduction
2. elastic fields of dislocations
3. slip, crystallography
4. equations of motion of dislocations
a) fcc
b) bcc
5. interaction between dislocations
6. molecular dynamics
7. discrete dislocation dynamics
8. continuum description of dislocations

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

1. D. Hull and D.J. Bacon, Introduction to Dislocations, Oxford Pergamon 1994
2. W. Cai and W. Nix, Imperfections in Crystalline Solids, Cambridge University Press, 2016
3. J.P. Hirth and J. Lothe: Theory of dislocations, New York Wiley 1982. (oder 1968)
4. J. Friedel, Dislocations, Pergamon Oxford 1964.
5. V. Bulatov, W. Cai, Computer Simulations of Dislocations, Oxford University Press 2006
6. A.S. Argon, Strengthening mechanisms in crystal plasticity, Oxford materials.

T 3.201 Course: Materials of Lightweight Construction [T-MACH-105211]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2174574	Materials for Lightweight Construction	2 SWS	Lecture (V)	Liebig, Elsner
Exams					
SS 2019	76-T-MACH-105211	Materials of Lightweight Construction		Prüfung (PR)	Liebig, Weidenmann

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Materials Science I/II

Below you will find excerpts from events related to this course:

V Materials for Lightweight Construction

2174574, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

Introduction

Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

learning objectives:
The students are capable to name different lightweight materials and can describe their composition, properties and fields of application. They can describe the hardening mechanisms of lightweight materials and can transfer this knowledge to applied problems.
The students can apply basic mechanical models of composites and can depict differences in the mechanical properties depending on composition and structure. The students can describe the basic principle of hybrid material concepts and can judge their advantages in comparison to bulk materials. The students can name special materials for lightweight design and depict differences to conventional materials. The students have the ability to present applications for different lightweight materials and can balance reasons for their use.
requirements:
Werkstoffkunde I/II (recommended)
workload:

The workload for the lecture “Materials for Lightweight Construction” is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

Learning Content

Introduction

Constructive, production-orientied and material aspects of lightweight construction

Aluminium-based alloys

Aluminium wrought alloys

Aluminium cast alloys

Magnesium-based alloys

Magnesium wrought alloys

Magnesium cast alloys

Titanium-based alloys

Titanium wrought alloys

Titanium cast alloys

High-strength steels

High-strength structural steels,

Heat-treatable steels, press-hardening and hardenable steels

Composites - mainly PMC

Matrices

Reinforcements

Basic mechanical principles of composites

Hybrid composites

Special materials for lightweight design

Beryllium alloys

Metallic Glasses

Applications

Workload

The workload for the lecture “Materials for Lightweight Construction” is 120 h per semester and consists of the presence during the lectures (24 h), preparation and rework time at home (48 h) and preparation time for the oral exam (48 h).

Literature

Presentation slides and additional lecture notes are handed out during the lecture, additional literature recommendations given

T 3.202 Course: Materials Physics and Metals [T-MACH-100285]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr. Astrid Pundt

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	13	Each winter term	2

Events					
SS 2019	2174598	Metals	3 SWS	Lecture (V)	Pundt, Heilmaier, Kauffmann
SS 2019	2174599	Übungen zur Vorlesung "Metalle"	1 SWS	Practice (Ü)	Heilmaier, Pundt, Kauffmann
WS 19/20	2177010	Materials Physics	3 SWS	Lecture (V)	Gruber
Exams					
SS 2019	76-T-MACH-100285	Materials Physics and Metals		Prüfung (PR)	Heilmaier, Gruber, Pundt
WS 19/20	76-T-MACH-100285	Materials Physics and Metals		Prüfung (PR)	Heilmaier, Gruber
WS 19/20	76-T-MACH-100285-W	Materials Physics and Metals		Prüfung (PR)	Heilmaier, Gruber, Pundt

Competence Certificate
Oral exam, about 45 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metals
2174598, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanicla and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.
requirements:
Materials physics
workload:

Regular attendance: 42 h

Self-study: 138 h

Learning Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Workload
Regular attendance: 42 h

Self-study: 138 h

Literature
D.A. Porter, K. Easterling, Phase Transformation in Metals and Alloys, 2nd edition, Chapman & Hall, London 1997,

J. Freudenberger: http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe

V **Übungen zur Vorlesung "Metalle"** **Practice (Ü)**
2174599, SS 2019, 1 SWS, Language: German, Open in study portal

Notes
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The Students have hands-on experience in the application of thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanicla and physical properties of metallic materials. This competence is in particular practiced for iron- and aluminum-based alloys.
requirements:
Materials physics
workload:

Regular attendance: 14 h

Self-study: 16 h

Learning Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Workload
Regular attendance: 14 h

Self-study: 16 h

Literature
G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)
J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
http://www.ifw-dresden.de/institutes/imw/lectures/pwe
P. Haasen: „Physikalische Metallkunde“, Cambridge University Press (2003)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810
R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656
D. A. Porter, K. Easterling: „Phase Transformation in Metals and Alloys“, Chapman & Hall (2009)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X
E. Hornbogen, H. Warlimont: „Metalle: Struktur und Eigenschaften von Metallen und Legierungen“, Springer (2016)
http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)
E. Hornbogen, G. Eggeler, E. Werner: „Werkstoffe: Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-22561-1 (frei über die KIT-Lizenz abrufbar)
H.-J. Bargel, G. Schulze: „Werkstoffkunde“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)
J. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)

T 3.203 Course: Materials Processing Technology [T-MACH-100295]

Responsible: Dr. Joachim Binder
Prof. Dr.-Ing. Kay Weidenmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	2

Events					
WS 19/20	2173540	Materials Processing Technology	3 SWS	Lecture / Practice (VÜ)	Liebig, Binder
Exams					
SS 2019	76-T-MACH-100295	Materials Processing Technology		Prüfung (PR)	Liebig, Weidenmann

Competence Certificate
Oral exam (lecture + lab course), approx. 25 min, lab course "Materials Processing" has to be finished successfully.

Prerequisites
Lab course "Materials Processing" has to be passed successfully in advance.

Annotation
Lecture: lecture notes, slides + beamer, blackboard

lab course: experimental equipment, paper, pencil, lab course notes, calculator

Below you will find excerpts from events related to this course:

V Materials Processing Technology
2173540, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

Lecture: lecture notes, slides + beamer, blackboard

lab course: experimental equipment, paper, pencil, lab course notes, calculator

Notes

Introduction

Polymers:

Raw materials, materials laws and models, rheology, moulding, forming, joining

Ceramics:

raw materials, powder synthesis, additives, moulding and forming of glass, moulding, abrasive techniques, changing properties, final processing

metals:

raw materials, materials processing, moulding, forming, cutting, joining

semiconductors:

raw materials, moulding, changing properties

Summary

objectives:

The students are able to name the different materials processing techniques and can the describe their basic principles and allocate them to the different classes of metarials processing methods.

They can chose specific processing techniques based on given problems and consider constraints derived from their basic knowledge in materials science.

The students are able to carry out simple experiments with lab scale equipment. They can correlate the processing parameters with resulting material properties by analyzing the materials using adequate testing methods which have to be chosen, evaluated and documented suitable to the problems given.

requirements:

none, **Recommendations:** Module "Basics in Materials Science" should be passed

workload:

The workload for the lecture “materials processing technology” is 180 h per semester and consists of the presence during the lectures (36 h) including tutorials, presence during the lab course (12 h), preparation and rework time at home (72 h) and preparation time for the oral exam (60 h).

Learning Content

Introduction

Polymers:

Raw materials, materials laws and models, rheology, moulding, forming, joining

Ceramics:

raw materials, powder synthesis, additives, moulding and forming of glass, moulding, abrasive techniques, changing properties, final processing

metals:

raw materials, materials processing, moulding, forming, cutting, joining

semiconductors:

raw materials, moulding, changing properties

Summary

Workload

The workload for the lecture “materials processing technology” is 180 h per semester and consists of the presence during the lectures (36 h) including tutorials, presence during the lab course (12 h), preparation and rework time at home (72 h) and preparation time for the oral exam (60 h).

Literature

Presentation slides and additional lecture notes are handed out during the lecture, additional literature recommendations given

T 3.204 Course: Materials Science and Engineering III [T-MACH-105301]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	1

Events					
WS 19/20	2173553	Materials Science and Engineering III	4 SWS	Lecture (V)	Heilmaier, Lang
WS 19/20	2173554	Übungen zu Werkstoffkunde III	1 SWS	Practice (Ü)	Heilmaier, Kauffmann
Exams					
SS 2019	76-T-MACH-105301	Materials Science III		Prüfung (PR)	Heilmaier, Lang

Competence Certificate
Oral exam, about 35 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Materials Science and Engineering III
2173553, WS 19/20, 4 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid states (nucleation and growth phenomena), the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatmens and of alloying on the microstructure and the properties of iron-based materials (steels in particular). The can select steels for structural applications in mechanical engineering and subject them to appropriate heat treatmens.

requirements:
Basic knowledge in materials science and engineering (Werkstoffkunde I/II)

workload:

regular attendance: 53 hours
self-study: 187 hours

Learning Content
Properties of pure iron; thermodynamic foundations of single-component and of binary systems; nucleation and growth; diffusion processes in crystalline iron; the phase diagram Fe-Fe3C; effects of alloying on Fe-C-alloys; nonequilibrium microstructures; multicomponent iron-based alloys; heat treatment technology; hardenability and hardenability tests.

Workload
regular attendance: 53 hours
self-study: 187 hours

Literature
Lecture Notes; Problem Sheets; Bhadeshia, H.K.D.H. & Honeycombe, R.W.K.
Steels – Microstructure and Properties
CIMA Publishing, 3. Auflage, 2006

T 3.205 Course: Mathematical Methods in Dynamics [T-MACH-105293]

Responsible: Prof. Dr.-Ing. Carsten Proppe
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	2

Events					
WS 19/20	2161206	Mathematical Methods in Dynamics	2 SWS	Lecture (V)	Proppe
WS 19/20	2161207	Übungen zu Mathematische Methoden der Dynamik	1 SWS	Practice (Ü)	Oestringer, Proppe

Competence Certificate
written examination, 180 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mathematical Methods in Dynamics

2161206, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Dynamics of continua:
Concept of continuum, geometry of continua, kinematics and kinetics of continua

Dynamics of rigid bodies:
Kinematics and kinetics of rigid bodies

Variational principles:
Priniciple of virtual work, variational calculations, Principle of Hamilto

Approximate solution methods:
Methods of weighted residuals, method of Ritz

Applications

Workload
Lectures and exercices: 32 h

Studies: 148 h

Literature
Lecture notes (available online)

J.E. Marsden, T.J.R. Hughes: Mathematical foundations of elasticity, New York, Dover, 1994

P. Haupt: Continuum mechanics and theory of materials, Berlin, Heidelberg, 2000

M. Riemer: Technische Kontinuumsmechanik, Mannheim, 1993

K. Willner: Kontinuums- und Kontaktmechanik : synthetische und analytische Darstellung, Berlin, Heidelberg, 2003

J.N. Reddy: Energy Principles and Variational Methods in applied mechanics, New York, 2002

A. Boresi, K.P. Chong, S. Saigal: Approximate solution methods in engineering mechanics, New York, 2003

V **Übungen zu Mathematische Methoden der Dynamik** **Practice (Ü)**
2161207, WS 19/20, 1 SWS, Language: German, Open in study portal

Learning Content
Excercises related to the lecture

T 3.206 Course: Mathematical Methods in Fluid Mechanics [T-MACH-105295]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2154432	Mathematical Methods in Fluid Mechanics	2 SWS	Lecture (V)	Frohnapfel, Stroh, Gatti
SS 2019	2154433	Tutorial in Mathematical Methods of Fluid Mechanics	1 SWS	Practice (Ü)	Frohnapfel, Stroh, Gatti
SS 2019	2154540	Mathematical Methods in Fluid Mechanics	SWS	Lecture (V)	Magagnato
Exams					
SS 2019	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics		Prüfung (PR)	Frohnapfel, Gatti
WS 19/20	76-T-MACH-105295	Mathematical Methods in Fluid Mechanics		Prüfung (PR)	Frohnapfel

Competence Certificate
written examination - 3 hours

Prerequisites
none

Recommendation
Basic Knowledge about Fluid Mechanics

Below you will find excerpts from events related to this course:

V Mathematical Methods in Fluid Mechanics
Lecture (V)
2154432, SS 2019, 2 SWS, Language: German/English, Open in study portal

Description
Media:

chalk board, Power Point

Notes

The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

The students can to simplify the Navier-Stokes equations for specific flow problems. They are able to employ mathematical method in fluid mechanics effectively in order to solve the resulting conservation equations analytically, if possible, or to enable simpler numerical access to the problem. They can describe the limits of applicability of the assumptions made to model the flow behavior.

Learning Content

The lecture will cover a selection of the following topics:

- Potential flow theory
- Creeping flows
- Lubrication theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Workload

regular attendance: 30 hours
self-study: 150 hours

Literature

Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Batchelor, G.K.: An Introduction to Fluid Dynamics, Cambridge Mathematical Library, 2000

Pope, S. B.: Turbulent Flows, Cambridge University Press, 2000

Ferziger, H., Peric, M.: Computational Methods for Fluid Dynamics, Springer, 2008

V **Tutorial in Mathematical Methods of Fluid Mechanics** **Practice (Ü)**

2154433, SS 2019, 1 SWS, Language: German, **Open in study portal**

Description

Media:

chalk board, Power Point

Notes

The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Learning Content
The exercises will practise the lecture topics:

- Curvilinear coordinates and tensor calculus
- Potential flow theory
- Boundary-layer theory
- Laminar-turbulent transition (linear stability theory)
- Turbulent flows
- Numerical solution of the governing equation (finite difference methods)

Workload
regular attendance: 10,5 hours
self-study: 49,5 hours

Literature
Kundu, P.K., Cohen, K.M.: Fluid Mechanics, Elsevier, 4th Edition, 2008

Batchelor, G.K.: An Introduction to Fluid Dynamics, Cambridge

Mathematical Library, 2000

Boiko, A. V., Grek, G. R., Dovgal, A. V., Kozlov, V. V.: The Origin of Turbulence in Near-Wall Flows, Springer, 2002

Pope, S. B.: Turbulent Flows, Cambridge University Press, 2000

Ferziger, H., Peric, M.: Computational Methods for Fluid Dynamics, Springer, 2008

T 3.207 Course: Mathematical Methods in Strength of Materials [T-MACH-100297]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	4

Competence Certificate
written exam (90 min). Additives as announced.

Prerequisites
Passing the Tutorial to Mathematical Methods of Strength of Materials

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-106830 - Tutorial Mathematical Methods in Strength of Materials must have been passed.

T 3.208 Course: Mathematical Methods in Structural Mechanics [T-MACH-105298]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each summer term	2

Events					
SS 2019	2162204	Sprechstunde zu Mathematische Methoden der Strukturmechanik	2 SWS	Consultation-hour (Sprechst.)	N.N.
SS 2019	2162280	Mathematical Methods in Micromechanics	2 SWS	Lecture (V)	Böhlke
Exams					
SS 2019	76-T-MACH-105298	Mathematical Methods in Structural Mechanics		Prüfung (PR)	Böhlke, Langhoff

Competence Certificate
written exam (180 min). Additives as announced.

Prerequisites
Passing the tutorial to Mathematical Methods in Structural Mechanics T-MACH-106831

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-106831 - Tutorial Mathematical Methods in Structural Mechanics must have been passed.

Recommendation
This course is geared to MSc students. The contents of the lecture "Mathematical methods in Strength of Materials" are assumed to be known.

Below you will find excerpts from events related to this course:

V Mathematical Methods in Micromechanics

Lecture (V)

2162280, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
I Basics of variational calculus

- functionals; Frechet-differential; Gateaux-differential; maximum or minimum problems
- lemma of variational calculus and Lagrange delta-process; Euler-Lagrange-equations

II Applications: Principals of continuums mechanics

- variational principals in mechanics; variational formulierung of boundary value problem of elastostatic

III Applications: Homogenization methods for materials with microstructure

- mesoscopic and macroskopic stress and strain measures
- Mean values of ensembles, ergodicity
- effective elastic properties
- Homogenization of thermo-elastic properties
- Homogenization of plastic and visco-plastic properties
- Fe-based homogenization

Workload
regular attendance: 31,5 hours
self-study: 118,5 hours

T 3.209 Course: Mathematical Methods of Vibration Theory [T-MACH-105294]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2019	2162241	Mathematical methods of vibration theory	2 SWS	Lecture (V)	Seemann
SS 2019	2162242	Mathematical methods of vibration theory (Tutorial)	2 SWS	Practice (Ü)	Seemann, Burgert
Exams					
SS 2019	76-T-MACH-105294	Mathematical Methods of Vibration Theory		Prüfung (PR)	Seemann

Competence Certificate
written examination, 180 min.

Prerequisites
none

Recommendation
Engineering Mechanics III/IV

Below you will find excerpts from events related to this course:

V Mathematical methods of vibration theory
2162241, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Linear, time-invariant, ordinary single differential equations: homogeneous solution; harmonic, periodic and non-periodic excitations; Duhamel's integral; Fourier and Laplace transform; introduction into the theory of distributions; Systems of ordinary differential equations: matrix notation, eigenvalue theory, fundamental matrix, forced vibrations via modal expansion and transition matrix; Introduction into the dynamic stability theory; Partial differential equations: solution in product form, eigenvalue theory, modal expansion using Ritz series; Variational methods, Hamilton's principle, boundary value problems representing vibrating continua; Perturbation methods

Workload
time of attendance: 24h; self-study: 65h

Literature
Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

V Mathematical methods of vibration theory (Tutorial)
2162242, SS 2019, 2 SWS, Language: German, Open in study portal

Practice (Ü)

Learning Content
Seven tutorials with examples of the contents of the course

Workload
time of attendance: 10,5h; self-study: 20h

Literature

Riemer, Wedig, Wauer: Mathematische Methoden der Technischen Mechanik

T 3.210 Course: Mathematical Models and Methods for Production Systems [T-MACH-105189]

Responsible: Marion Baumann
Prof. Dr.-Ing. Kai Furmans

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2117059	Mathematical models and methods for Production Systems	4 SWS	Lecture (V)	Baumann, Furmans

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mathematical models and methods for Production Systems
2117059, WS 19/20, 4 SWS, Language: English, Open in study portal

Lecture (V)

Notes
Media:

black board, lecture notes, presentations

Learning Content:

- single server systems: M/M/1, M/G/1: priority rules, model of failures
- networks: open and closed approximations, exact solutions and approximations
- application to flexible manufacturing systems, AGV (automated guided vehicles) - systems
- modeling of control approaches like constant work in process (ConWIP) or kanban
- discrete-time modeling of queuing systems

Learning Goals:

Students are able to:

- Describe queueing systems with analytical solvable stochastic models,
- Derive approches for modeling and controlling material flow and production systems based on models of queueing theory,
- Use simulation and exakt methods.

Recommendations:

- Basic knowledge of statistic
- recommended compusory optional subject: Stochastics
- recommended lecture: Materials flow in logistic systems (also parallel)

Workload:

regular attendance: 42 hours
self-study: 198 hours

T 3.211 Course: Mathematical Models and Methods in Combustion Theory [T-MACH-105419]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2165525	Mathematical models and methods in combustion theory	2 SWS	Lecture (V)	Bykov

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mathematical models and methods in combustion theory

2165525, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The lecture shall introduce the basics of the mathematical modeling and the analysis of reacting flow systems. The fundamental models of combustion processes are outlined together with asymptotical methods, which deliver reasonable approximate solutions for numerous combustion processes. Many examples of simplified models for the description of auto-ignition, explosions, flame quenching and detonations will be presented and discussed. The main analytical methods will be illustrated using these simple examples.

Workload
Regular attendance: 22.5 h

Self-study: 97.5 h

Literature
Combustion Theory, F A Williams, (2nd Edition), 1985, Benjamin Cummins.

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, J. Warnatz, U. Mass and R. W. Dibble, (3nd Edition), Springer-Verlag, Heidelberg, 2003.

The Mathematical Theory of Combustion and Explosions, Ya.B. Zeldovich, G.I. Barenblatt, V.B. Librovich, G.M. Makhviladze, Springer, New York and London, 1985.

T 3.212 Course: Measurement II [T-MACH-105335]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2138326	Measurement II	2 SWS	Lecture (V)	Stiller, Wirth
Exams					
SS 2019	76-T-MACH-105335	Measurement II		Prüfung (PR)	Stiller

Competence Certificate
written exam

60 min.

2 DIN A4 Self-created formular sheets allowed

Prerequisites
none

Below you will find excerpts from events related to this course:

V Measurement II
2138326, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Lerninhalt (EN)

1. Amplifiers
2. Digital technology
3. Stochastic modeling for measurement applications
4. Estimation
5. Kalman Filter
6. Environmental perception

Lernziele (EN):

The capabilities of modern sensor technology pave the way for novel applications in engineering. Especially digital measurement techniques may be used even in very complex environments and thus have strong impact on technological progress. Stochastic models of measurement processes form the basis for meaningful information processing and provide a valuable tool for engineering. This interdisciplinary lecture addresses students in mechanical engineering and related subjects. The lecture gives an overview of digital technology and stochastics. These areas form the basics of estimation methods that can be embedded elegantly in the theory of state observers. Applications in signal processing for modern environmental perception (video, Lidar, Radar) illustrate the discussed subjects.

Learning Content
1. Amplifiers
2. Digital technology
3. Stochastic modeling for measurement applications
4. Estimation
5. Kalman Filter
6. Environmental perception

Workload
120 hours

Literature
Various Scripts

T 3.213 Course: Measurement Instrumentation Lab [T-MACH-105300]

Responsible: Max Spindler
Prof. Dr.-Ing. Christoph Stiller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2138328	Measurement Instrumentation Lab	2 SWS	Practical course (P)	Stiller, Richter

Competence Certificate
Non graded colloquia

Prerequisites
none

Below you will find excerpts from events related to this course:

V Measurement Instrumentation Lab

2138328, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Notes
Please consider the bulletin on our website!

A Signal recording

- measurement of temperature
- measurement of lengths

B Signal pre-precessing

- bridge circuits and principles of measurement
- analog/digital transducers

C Signal processing

- measuring stochastic signals

D Complete systems

- system identification
- inverse pendulum
- mobile robot platform

Recommendations:

Basic studies and preliminary examination; basic lectures in automatic control

Arbeitsaufwand: 90 hours

Lernziele (EN):

The laboratory complements the course "Introduction to Measurement and Control". While the course is organized into principles and subsystems, the laboratory presents complete measurement systems and methods for the most relevant industrial measurands.

Learning Content

A Signal recording

- measurement of temperature
- measurement of lengths

B Signal pre-precessing

- bridge circuits and principles of measurement
- analog/digital transducers

C Signal processing

- measuring stochastic signals

D Complete systems

- system identification
- inverse pendulum
- mobile robot platform

Workload

90 hours

T 3.214 Course: Mechanics and Strength of Polymers [T-MACH-105333]

Responsible: Prof. Dr.-Ing. Bernd-Steffen von Bernstorff
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2173580	Mechanics and Strengths of Polymers	2 SWS	Lecture (V)	von Bernstorff

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Basic knowledge in materials science (e.g. lecture materials science I and II)

Below you will find excerpts from events related to this course:

V Mechanics and Strengths of Polymers

2173580, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

learning objectives:

The students are prepared to

- repeat the calculus on strength and design of engineering parts exposed to complex loadings,
- estimate the influence of time and temperature on the strength of polymeric materials,
- relate the strength of materials to their molecular structure, morphology and processing parameters and
- derive failure mechanisms for homogenuous polymers and composite materials therefrom.

requirements:
basic knowledge in materials science (e.g. lecture materials science I and II)

workload:

The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

Learning Content
Molecular structure and morphology of polymers, temperature- and time dependency of mechanical behavior, viscoelasticity, time/temperature- superposition principle, yielding, crazing and fracture of polymers, failure criterions, impact and dynamic loading, corresponding principle, tough/brittle-transition, introduction to the principles of fiber reinforcement and multiple cracking in composites

Workload
The workload for the lecture Mechanics and Strengths of Polymers is 120 h per semester and consists of the presence during the lecture (28 h) as well as preparation and rework time at home (92 h).

Literature
A literature list, specific documents and partial lecture notes shall be handed out during the lecture.

T 3.215 Course: Mechanics in Microtechnology [T-MACH-105334]

Responsible: Dr. Christian Greiner
Dr. Patric Gruber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2181710	Mechanics in Microtechnology	2 SWS	Lecture (V)	Gruber, Greiner
Exams					
SS 2019	76-T-MACH-105334	Mechanics in Microtechnology		Prüfung (PR)	Gruber

Competence Certificate
Oral examination, ca. 30 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Mechanics in Microtechnology

2181710, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechnical Parameters such as Young'sModulus and YieldDtrength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Elektrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,...

The students know and understand size and scaling effects in micro- and nanosystems. They understand the impact of mechanical phenomena in small dimensions. Based on this they can judge how they determine material processing as well as working principles and design of microsensors and microactuators.

regular attendance: 22,5 hours
self-study: 97,5 hours

oral exam ca. 30 minutes

Learning Content
1. Introduction: Application and Processing of Microsystems
2. Scaling Effects
3. Fundamentals: Stress and Strain, (anisotropic) Hooke's Law
4. Fundamentals: Mechanics of Beams and Membranes
5. Thin Film Mechanics: Origin and Role of Mechanical Stresses
6. Characterization of Mechanical Properties of Thin Films and Small Structures: Measurement of Stresses and Mechnical Parameters such as Young'sModulus and YieldDtrength; Thin Film Adhesion and Stiction
7. Transduction: Piezo-resistivity, Piezo-electric Effect, Elektrostatics,...
8. Aktuation: Inverse Piezo-electric Effect, Shape Memory, Elektromagnetic Actuation,...

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
Folien,
1. M. Ohring: "The Materials Science of Thin Films", Academic Press, 1992
2. L.B. Freund and S. Suresh: "Thin Film Materials"
3. M. Madou: Fundamentals of Microfabrication", CRC Press 1997
4. M. Elwenspoek and R. Wiegerink: "Mechanical Microsensors" Springer Verlag 2000
5. Chang Liu: Foundations of MEMS, Illinois ECE Series, 2006

T 3.216 Course: Mechatronical Systems and Products [T-MACH-105574]

Responsible: Prof. Dr.-Ing. Sören Hohmann
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	2

Events					
WS 19/20	2303003	Tutorial for 2303161 Mechatronical Systems and Products	1 SWS	Practice (Ü)	Schwartz, Hölz
WS 19/20	2303161	Mechatronical Systems and Products	2 SWS	Lecture (V)	Matthiesen, Hohmann

Competence Certificate
written examination (duration: 60min)

Prerequisites
Successful participation in the workshop Mechatronic Systems and Products is mandatory for admission to the examination.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108680 - Workshop Mechatronical Systems and Products must have been passed.

Annotation
All relevant content (scripts, exercise sheets, etc.) for the course can be obtained via the eLearning platform ILIAS. To participate in the course, please complete the survey " Anmeldung und Gruppeneinteilung " in ILIAS before the start of the semester.

T 3.217 Course: Medical Imaging Techniques I [T-ETIT-101930]

Responsible: Prof. Dr. Olaf Dössel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Events					
WS 19/20	2305261	Medical Imaging Techniques I	2 SWS	Lecture (V)	Dössel

Prerequisites
none

T 3.218 Course: Medical Imaging Techniques II [T-ETIT-101931]

Responsible: Prof. Dr. Olaf Dössel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	2305262	Medical Imaging Techniques II	2 SWS	Lecture (V)	Dössel
Exams					
SS 2019	7305262	Medical Imaging Techniques II		Prüfung (PR)	Dössel

T 3.219 Course: Medical Robotics [T-INFO-101357]

Responsible: Prof. Dr.-Ing. Torsten Kröger
Jun.-Prof. Dr. Franziska Mathis-Ullrich

Organisation: KIT Department of Informatics

Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	24681	Medical Robotics	2 SWS	Lecture (V)	Mathis-Ullrich
Exams					
SS 2019	7500129	Medical Robotics		Prüfung (PR)	Mathis-Ullrich

T 3.220 Course: Metal Forming [T-MACH-105177]

Responsible: Dr.-Ing. Thomas Herlan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2150681	Metal Forming	2 SWS	Lecture (V)	Herlan
Exams					
SS 2019	76-T-MACH-105177	Metal Forming		Prüfung (PR)	Schulze

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metal Forming
2150681, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed
by product samples from the forming technology.

The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

Learning Outcomes:

The students ...

- are able to reflect the basics, forming processes, tools, Machines and equipment of metal forming in an integrated and systematic way.
- are capable to illustrate the differences between the forming processes, tools, machines and equipment with concrete examples and are qualified to analyze and assess them in terms of their suitability for the particular application.
- are also able to transfer and apply the acquired knowledge to other metal forming problems.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

At the beginning of the lecture the basics of metal forming are briefly introduced. The focus of the lecture is on massive forming (forging, extrusion, rolling) and sheet forming (car body forming, deep drawing, stretch drawing). This includes the systematic treatment of the appropriate metal forming Machines and the corresponding tool technology. Aspects of tribology, as well as basics in material science and aspects of production planning are also discussed briefly. The plastic theory is presented to the extent necessary in order to present the numerical simulation method and the FEM computation of forming processes or tool design. The lecture will be completed
by product samples from the forming technology.
The topics are as follows:

- Introduction and basics
- Hot forming
- Metal forming machines
- Tools
- Metallographic fundamentals
- Plastic theory
- Tribology
- Sheet forming
- Extrusion
- Numerical simulation

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

T 3.221 Course: Metallographic Lab Class [T-MACH-105447]

Responsible: Ulla Hauf
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	2

Events					
SS 2019	2175590	Metallographic Lab Class	3 SWS	Practical course (P)	Mühl
WS 19/20	2175590	Metallographic Lab Class	3 SWS	Practical course (P)	Mühl
Exams					
SS 2019	76-T-MACH-105447	Metallographic Lab Class		Prüfung (PR)	Heilmaier

Competence Certificate
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metallographic Lab Class

2175590, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes

learning objectives:

requirements:

workload:

V Metallographic Lab Class

2175590, WS 19/20, 3 SWS, Language: German, Open in study portal

Practical course (P)

Notes

Light microscope in metallography

metallographic sections of metallic materials

Investigation of the microstructure of unalloyed steels and cast iron

Microstructure development of steels with accelerated cooling from the austenite area

Investigation of microstructures of alloyed steels

Investigation of failures quantitative microstructural analysis

Microstructural investigation of technically relevant non-ferrous metals

Application of Scanning electron microscope

learning objectives:
The students in this lab class gain are able to perform standard metallographic preparations and are able to apply standard software for quantitative microstructural analyses. Based on this the student can interpret unetched as well as etched microstructures with respect to relevant microstructural features. They can draw concluding correlations between heat treatments, ensuing microstructures and the resulting mechanical as well as physical properties of the investigated materials.

requirements:
Material Science I/II

workload:

The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).

Learning Content

Light microscope in metallography

metallographic sections of metallic materials

Investigation of the microstructure of unalloyed steels and cast iron

Microstructure development of steels with accelerated cooling from the austenite area

Investigation of microstructures of alloyed steels

Investigation of failures quantitative microstructural analysis

Microstructural investigation of technically relevant non-ferrous metals

Application of Scanning electron microscope

Workload

The workload for the Metallographic Lab Class is 120 h per semester and consists of the presence during the lab course (25 h) as well as preparation and rework time at home (95 h).

Literature

E. Macherauch: Praktikum in Werkstoffkunde, 10th edition, 1992

H. Schumann: Metallographie, 13th edition, Deutscher Verlag für Grundstoffindustrie, 1991

Literature List will be handed out with each experiment

T 3.222 Course: Metals [T-MACH-105468]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Prof. Dr. Astrid Pundt

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2174598	Metals	3 SWS	Lecture (V)	Pundt, Heilmaier, Kauffmann
SS 2019	2174599	Übungen zur Vorlesung "Metalle"	1 SWS	Practice (Ü)	Heilmaier, Pundt, Kauffmann
Exams					
SS 2019	76-T-MACH-105468	Metals		Prüfung (PR)	Heilmaier
WS 19/20	76-T-MACH-105468	Metals		Prüfung (PR)	Heilmaier, Pundt

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Metals
2174598, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The students are familiar with the thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships and can apply them to metallic materials. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanicla and physical properties of metallic materials. This competence is in particular deepened for iron- and aluminum-based alloys.
requirements:
Materials physics
workload:

Regular attendance: 42 h

Self-study: 138 h

Learning Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Workload
Regular attendance: 42 h

Self-study: 138 h

Literature
D.A. Porter, K. Easterling, Phase Transformation in Metals and Alloys, 2nd edition, Chapman & Hall, London 1997,

J. Freudenberger: http://www.ifw-dresden.de/institutes/imw/lectures/lectures/pwe

V Übungen zur Vorlesung "Metalle"
2174599, SS 2019, 1 SWS, Language: German, Open in study portal

Practice (Ü)

Notes
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

learning objectives:
The Students have hands-on experience in the application of thermodynamic foundations of phase transformations, the kinetics of phase transformations in the solid state, the mechanisms of microstructure formation and microstructure-property relationships. They can assess the effects of heat treatments and of alloying on the microstructure and the mechanicla and physical properties of metallic materials. This competence is in particular practiced for iron- and aluminum-based alloys.
requirements:
Materials physics
workload:

Regular attendance: 14 h

Self-study: 16 h

Learning Content
Properties of pure elements; thermodynamic foundations of single-component and of binary systems, as well as multiphase systems; nucleation and growth; diffusion processes in crystalline materials; phase diagrams; effects of alloying; nonequilibrium microstructures; heat treatment technology

Workload
Regular attendance: 14 h

Self-study: 16 h

Literature
G. Gottstein: „Materialwissenschaft und Werkstofftechnik: Physikalische Grundlagen“, Springer (2014)
http://dx.doi.org/10.1007/978-3-642-36603-1 (frei über die KIT-Lizenz abrufbar)
J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
http://www.ifw-dresden.de/institutes/imw/lectures/pwe
P. Haasen: „Physikalische Metallkunde“, Cambridge University Press (2003)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC309606810
R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656
D. A. Porter, K. Easterling: „Phase Transformation in Metals and Alloys“, Chapman & Hall (2009)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X
E. Hornbogen, H. Warlimont: „Metalle: Struktur und Eigenschaften von Metallen und Legierungen“, Springer (2016)
http://dx.doi.org/10.1007/978-3-662-47952-0 (frei über die KIT-Lizenz abrufbar)
E. Hornbogen, G. Eggeler, E. Werner: „Werkstoffe: Aufbau und Eigenschaften von Keramik-, Metall-, Polymer- und Verbundwerkstoffen“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-22561-1 (frei über die KIT-Lizenz abrufbar)
H.-J. Bargel, G. Schulze: „Werkstoffkunde“, Springer (2012)
http://dx.doi.org/10.1007/978-3-642-17717-0 (frei über die KIT-Lizenz abrufbar)
J. Rösler, H. Harders, M. Bäker: „Mechanisches Verhalten der Werkstoffe“, Springer Vieweg (2016)
http://dx.doi.org/10.1007/978-3-658-13795-3 (frei über die KIT-Lizenz abrufbar)

T 3.223 Course: Methods and Processes of PGE - Product Generation Development [T-MACH-109192]

Responsible: Prof. Dr.-Ing. Albert Albers
Norbert Burkardt
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2146176	Methods and processes of PGE - Product Generation Development	3 SWS	Lecture (V)	Albers
Exams					
SS 2019	76-T-MACH-105382	Product Development - Methods of Product Development		Prüfung (PR)	Albers
SS 2019	76-T-MACH-105382-en	Methods and Processes of PGE - Product Generation Engineering		Prüfung (PR)	Albers

Competence Certificate
Written exam (processing time: 120 min + 10 min reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Prerequisites
None

Annotation
This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Below you will find excerpts from events related to this course:

V Methods and processes of PGE - Product Generation Development

Lecture (V)

2146176, SS 2019, 3 SWS, Language: German, Open in study portal

Notes

Note:

This lecture is the basis for the main subject Integrated Product Development, which is offered as a specialisation.

Recommendations:

none

Workload:

regular attendance: 31.5 h

self-study: 148.5 h

Examination:

Written exam

Duration: 120 minutes (+10 minutes reading time)

Auxiliaries:

- Calculator
- German dictionary (books only)

Course content:

Basics of Product Development: Basic Terms, Classification of the Product
Development into the industrial environment, generation of costs / responsibility for costs
Concept Development: List of demands / Abstraction of the Problem Definition / Creativity Techniques / Evaluation and selection of solutions
Drafting : Prevailing basic rules of Design / Design Principles as a
problem oriented accessory
Rationalization within the Product Development: Basics of Development
Management/ Simultaneous Engineering and Integrated Product Development/Development of Product
Lines and Modular Construction Systems
Quality Assurance in early Development Phases : Methods of Quality Assurance
in an overview/QFD/FMEA

Learning objectives:

The students are able to ...

- classify product development in companies and differentiate between different types of product development.
- name the relevant influencing factors of a market for product development.
- name, compare and use the central methods and process models of product development within moderate complex technical systems.
- explain problem solving techniques and associated development methods.
- explain product profiles and to differentiate and choose suitable creative techniques of solution/idea generation finding on this basis.
- use design guidelines to create simple technical systems and to explain these guidelines.
- name and compare quality assurance methods; to choose and use suitable methods for particular applications.
- explain the differents methods of design of experiment.
- explain the costs in development process.

T 3.224 Course: Methods of Signal Processing [T-ETIT-100694]

Responsible: Prof. Dr.-Ing. Fernando Puente León
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	1

Events					
WS 19/20	2302113	Methods of Signal Processing	2 SWS	Lecture (V)	Puente León
WS 19/20	2302115	Methods of Signal Processing (Tutorial to 2302113)	1+1 SWS	Practice (Ü)	Puente León, Krippner
Exams					
SS 2019	7302113	Methods of Signal Processing		Prüfung (PR)	Puente León

Prerequisites
none

T 3.225 Course: Micro- and nanosystem integration for medical, fluidic and optical applications [T-MACH-108809]

Responsible: Dr. Ulrich Gengenbach
Prof. Dr. Veit Hagenmeyer
Dr. Liane Koker
PD Dr.-Ing. Ingo Sieber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2105032	Micro- and nanosystem integration for medical, fluidic and optical applications	2 SWS	Lecture (V)	Koker, Gengenbach, Sieber
Exams					
SS 2019	76-T-MACH-108809	Micro- and nanosystem integration for medical, fluidic and optical applications		Prüfung (PR)	Koker, Gengenbach, Sieber

Competence Certificate
Oral exam (Duration: 30min)

Prerequisites
T-MACH-105695 "Selected topics of system integration for micro- and nanotechnology" must not be started.

Below you will find excerpts from events related to this course:

V Micro- and nanosystem integration for medical, fluidic and optical applications

Lecture (V)

2105032, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

Content:

- Introduction to the role of system integration in the product development process
- Simplistic modeling and use of analogies in system design
- Introduction to modeling and simulation in system design
- Mechanics simulation
- Optics simulation
- Fluidics simulation
- Coupling of simulation tools
- Requirements for system integration of active implants
- Design of active implants
- Approaches to system integration of active implants
- Test methods (hermeticity, accelerated aging etc.)
- Micro-optical subsystems
- Micro-fluidic subsystems
- Self-assembly as integration process at micro and nano scale

Learning objectives:

The students ...:

- have a fundamental understanding of modeling using analogies
- know the basics of modeling and simulation in design of mechanical, optical, and fluidic subsystems
- can assess the need for inter-domain simulations
- understand the challenges in the design of active implants
- have an overview of different active implants and their applications
- know approaches to system integration and packaging of active implants
- are familiar with different methods of testing with the focus on hermeticity
- have an overview of processes for the integration of micro-optical and micro-fluidic subsystems
- gain insight into technical applications of self-assembly processes

Learning Content

- Introduction to the role of system integration in the product development process
- Simplistic modeling and use of analogies in system design
- Introduction to modeling and simulation in system design
- Mechanics simulation
- Optics simulation
- Fluidics simulation
- Coupling of simulation tools
- Requirements for system integration of active implants
- Design of active implants
- Approaches to system integration of active implants
- Test methods (hermeticity, accelerated aging etc.)
- Micro-optical subsystems
- Micro-fluidic subsystems
- Self-assembly as integration process at micro and nano scale

Workload

regular attendance: 21 hours
self-study: 99 hours

T 3.226 Course: Micro Magnetic Resonannce [T-MACH-105782]

Responsible: Prof. Dr. Jan Gerrit Korvink
Dr. Neil MacKinnon

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each winter term	1

Events					
WS 19/20	2141501	Micro Magnetic Resonance	2 SWS	Seminar (S)	MacKinnon, Badilita, Jouda, Korvink

Competence Certificate
Own Presentation, participation at the course discussions, result is passed or failed.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Micro Magnetic Resonance

Seminar (S)

2141501, WS 19/20, 2 SWS, Language: English, Open in study portal

Learning Content
Nuclear magnetic resonance (NMR), or magnetic resonance in general (MR) is a powerful, non-invasive technique useful for gaining atomic level structural details on samples ranging from soluble small molecules to large membrane bound proteins. Traditional NMR hardware used for exciting the sample and detecting the signal is traditionally on the macroscale in terms of physical dimensions. Recently, miniaturization of NMR systems has developed into an active research area driven primarily by the enhanced mass sensitivity and the ability for system integration with smaller NMR detectors. In this seminar course, we will explore some of the state-of-the-art applications of micro-NMR, including visiting research laboratories within Germany active in micro-MR. A selection of representative research papers will be provided, from which each student will select one paper to learn in depth and finally present in a style as if they performed the research themselves. The course will first offer a series of introductory lectures, followed by a series of tutorial sessions in which each student may discuss with experts. Finally, individual student presentations with discussion will be held.

Topics to be offered:

- Novel micro-NMR detectors (solenoid, strip line, microslot, CMOS, printed, etc.)
- Novel nano-MR detectors (MRFM, NV centers, etc.)
- Computation (design optimization, MOR, MRI image processing, NMR spectral prediction, etc.)
- Signal enhancement strategies (hyperpolarization DNP, PHiP, Xe, refrigeration)
- System hyphenation (chromatography, flow cells, LoC, orthogonal analysis, etc.)
- Complex mixtures (metabolomics, in vivo applications on small organisms)
- Biomedical MR sensors (catheters, implantable, etc.)

Workload
Course participation 28 h

Preparation of own lecture 60 h

Self study time 35 h

Literature
Links to allliterature journal articles will be provided to the students. Example research journal sources will include Nature, Nature Communications, Science, PNAS, JMR, etc. For general reading, some recommended sources are:

- Principles of Nuclear Magnetic Resonance Microscopy, Callaghan, P (1994), Oxford University Press.
- Spin Dynamics: Basics of Nuclear Magnetic Resonance 2nd Ed., Levitt, M (2013), John Wiley & Sons.
- NMR Probeheads for Biophysical and Biomedical Experiments – Theoretical Principles, Mispelter, J; Lupu, M; Briguet, A (2006) Imperial College Press.

T 3.227 Course: Microactuators [T-MACH-101910]

Responsible: Prof. Dr. Manfred Kohl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2142881	Microactuators	2 SWS	Lecture (V)	Kohl
Exams					
SS 2019	76-T-MACH-101910	Microactuators		Prüfung (PR)	Kohl

Competence Certificate
written exam, 60 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microactuators

2142881, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Script of ppt-slides

Learning Content
- Basic knowledge in the material science of the actuation principles
- Layout and design optimization
- Fabrication technologies
- Selected developments
- Applications

The lecture includes amongst others the following topics:

- Microelectromechnical systems: linear actuators, microrelais, micromotors
- Medical technology and life sciences: Microvalves, micropumps, microfluidic systems
- Microrobotics: Micrograppers, polymer actuators (smart muscle)
- Information technology: Optical switches, mirror systems, read/write heads

Annotation
Details will be announced at the beginning of the lecture

Workload
lecture time 1.5 h/week

self preparation: 8.5 h/week

Literature

- Lecture notes

- D. Jendritza, Technischer Einsatz Neuer Aktoren: Grundlagen, Werkstoffe, Designregeln und Anwendungsbeispiele, Expert-Verlag, 3. Auflage, 2008

- M. Kohl, Shape Memory Microactuators, M. Kohl, Springer-Verlag Berlin, 2004

- N.TR. Nguyen, S.T. Wereley, Fundamentals and applications of Microfluidics, Artech House, Inc. 2002

- H. Zappe, Fundamentals of Micro-Optics, Cambride University Press 2010

T 3.228 Course: Microenergy Technologies [T-MACH-105557]

Responsible: Prof. Dr. Manfred Kohl
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2142897	Microenergy Technologies	2 SWS	Lecture (V)	Kohl
Exams					
SS 2019	76-T-MACH-105557	Microenergy Technologies		Prüfung (PR)	Kohl

Competence Certificate
Oral examination (30 Min.)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microenergy Technologies — Lecture (V)
2142897, SS 2019, 2 SWS, Language: English, Open in study portal

Learning Content
- Basic physical principles of energy conversion
- Layout and design optimization
- Technologies
- Selected devices
- Applications

The lecture includes amongst others the following topics:

Micro energy harvesting of vibrations

Thermal micro energy harvesting

Microtechnical applications of energy harvesting

Heat pumps in micro technology

Micro cooling

Workload
time of attendance: 1.5 hours/week

Self-study: 8.5 hours/week

Literature
- Lecture notes (overhead transparencies) "Micro Energy Technologies"
- Stephen Beeby, Neil White, Energy Harvesting for Autonomous Systems, Artech House, 2010
- Shashank Priya, Daniel J. Inman, Energy Harvesting Technologies, Springer, 2009

T 3.229 Course: Microsystem Simulation [T-MACH-108383]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2142875	Microsystem Simulation	3 SWS	Lecture / Practice (VÜ)	Korvink

Competence Certificate
written exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Microsystem Simulation

2142875, SS 2019, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)

Learning Content
This lecture consists of the following 12 topics, one presented each week of semester:

1. The Act of Modelling
2. Mathematica Introduction
3. Equation Types
4. Approximation and Integration
5. Differentiation and Finite Differences
6. Geometry and Meshing
7. Weighted Residual Methods
8. Finite Element Method
9. Numerical Solving
10. Computational Post-processing
11. Program Structure
12. Commercial Programs

Attendees will first learn how to approach the modelling process. Afterwards, they will learn the fundamental numerical mathematics techniques with which to form numerical simulation models, which in turn will lead to computational programs. The lecture offers one hour of exercises where students can consult the lecturers on the topics of the lecture. Students are offered numerous learning goals per chapter, to simplify the attendence of lectures.

Students are expected to work with the program Mathematica ® to complete their exercises. It provides a symbolical and numerical environment, and offers high level graphics for ease of programming. All programming exercises will be in Mathematica ®, so as to speed up the learning process.

The written examination questions draw from the examples provided during the lecture (recorded on the slides and on the black board during class) as well as from the exercises.

Annotation
Examinations take place during the lecture free periods. The dates are provided at the beginning of semester.

Workload
lectures: 30 hours

self study: 60 hours

preparation for examination: 30 hours

Literature
The following references are usedby the lecturers to prepare the lecture.Students are not required to access most of these, but of course it does not hurt! Hints for efficient further reading, depending on interest, will be provided during the lecture.

- E. Buckingham, On physically similar systems: illustrations on the use of dimensional equations, Phys. Rev. 4, 345–376 (1914)
- E. Buckingham, Model Experiments and the Forms of Empirical Equations, ASME 263–296 (1915)
- K. Eriksson, D. Estep, P. Hansbo, C. Johnson, Computational Differential Equations, Cambridge University Press, Cambridge (1996)
- Bengt Fornberg, Calculation of Weights in Finite Difference Formulas, SIAM Rev. 40(3) 1998
- Gene H. Golub, Charles F. van Loan, Matrix Computations, John Hopkins University Press 1996
- H. Hanche-Olsen, Buckingham's pi-theorem, Internet (2004)
- Arieh Iserles, A First Course in the Numerical Analysis of Differential Equations, Cambridge University Press, Cambridge (1996)
- Mathematica Help Documentation
- N. Metropolis, A.W. Rosenbluth, M.N. Rosenbluth. A.H. Teller and E. Teller, "Equation of State Calculations by Fast Computing Machines, J. Chem. Phys. 21 (1953) 1087-1092.
- Rick Beatson and Leslie Greengard, A short course on fast multipole methods

T 3.230 Course: Mobile Machines [T-MACH-105168]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	8	Each summer term	1

Events					
SS 2019	2114073	Mobile Machines	4 SWS	Lecture (V)	Geimer, Geiger
Exams					
SS 2019	76T-MACH-105168	Mobile Machines		Prüfung (PR)	Geimer
SS 2019	76-T-MACH-105168	Mobile Machines		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-105168	Mobile Machines		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an oral exam (45 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
none

Recommendation
Knowledge in Fluid Power Systems is required. It is recommended to attend the course *Fluid Power Systems* [2114093] beforehand.

Annotation
After completion of the course the students have knowledge of:

- a wide range of mobile machines
- operation modes and working cycles of importmant mobile machines
- selected subsystems and components

Content:

- Introduction of the required components and machines
- Basics and structure of mobile machines
- Practical insight in the development techniques

Below you will find excerpts from events related to this course:

V Mobile Machines

Lecture (V)

2114073, SS 2019, 4 SWS, Language: German, Open in study portal

Description
Media:
Lecture notes.

Learning Content

- Introduction of the required components and machines
- Basics of the structure of the whole system
- Practical insight in the development techniques

Workload

- regular attendance: 42 hours
- self-study: 184 hours

T 3.231 Course: Modeling and Simulation [T-MACH-105297]

Responsible: Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Marcus Geimer
Dr. Balazs Pritz
Prof. Dr.-Ing. Carsten Proppe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	7	Each winter term	1

Events					
WS 19/20	2185227	Modelling and Simulation	2 SWS	Lecture (V)	Proppe, Furmans, Pritz, Geimer
WS 19/20	2185228	Übungen zu Modellbildung und Simulation	2 SWS	Practice (Ü)	Proppe, Bykov, Pritz, Völker, Furmans, Bolender, Fischer
Exams					
SS 2019	7600019	Modeling and Simulation		Prüfung (PR)	Proppe, Furmans, Geimer

Competence Certificate
The assessment consists of a 180 minutes written examination.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modelling and Simulation
2185227, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations

Learning Content
Introduction: Overview, concept formation, simulation studies, time/event-discrete models, event-oriented/process orientated/transaction-oriented view, typical model classes (operation/maintenance, storekeeping, loss-susceptible systems)

Time-continuous models with concentrated parameters, model characteristics and model analysis Numerical treatment of ordinary differential equations and differential-algebraic sets of equations coupled simulations with concentrated parameters

Time-continuous models with distributed parameters, description of systems by means of partial differential equations, model reduction, numerical solution procedures for partial differential equations

Annotation
none

Workload
regular attendance: 42 hours
self-study: 168 hours

Literature
None.

T 3.232 Course: Modeling of Thermodynamical Processes [T-MACH-105396]

Responsible: Prof. Dr. Ulrich Maas
Dr.-Ing. Robert Schießl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each term	1

Events					
SS 2019	2167523	Modeling of Thermodynamical Processes	3 SWS	Lecture (V)	Maas, Schießl
WS 19/20	2167523	Modeling of Thermodynamical Processes	3 SWS	Lecture (V)	Schießl, Maas

Competence Certificate
Oral exam (30 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modeling of Thermodynamical Processes
Lecture (V)
2167523, SS 2019, 3 SWS, Language: German, Open in study portal

Learning Content
Thermodynamic basics
Numerical solver strategies for algebraic equations
Optimization issues
Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

Workload
regular attendance: 32 hours

Self-study, exam preporation, Prüfungsvorleistung: 150,0 hours

Literature
Lecture notes

Numerical Recipes C, FORTRAN; Cambridge University Press
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973

J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

V Modeling of Thermodynamical Processes
Lecture (V)
2167523, WS 19/20, 3 SWS, Language: German, Open in study portal

Learning Content
Thermodynamic basics
Numerical solver strategies for algebraic equations
Optimization issues
Ordinary and partial differential equations
Application to various problems in thermodynamics (engine processes, determination of equilibrium states, unsteady processes in inhomogeneous systems)

Workload
regular attendance: 33.8 h

Self-study, exam preporation, Prüfungsvorleistung: 146.3 h

Literature
Lecture notes

Numerical Recipes C, FORTRAN; Cambridge University Press
R.W. Hamming; Numerical Methods for scientists and engineers; Dover Books On Engineering; 2nd edition; 1973

J. Kopitz, W. Polifke; Wärmeübertragung; Pearson Studium; 1. Auflage

T 3.233 Course: Modelling and Simulation [T-MACH-100300]

Responsible: Prof. Dr. Peter Gumbsch
Prof. Dr. Britta Nestler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	5	Each term	2

Events					
SS 2019	2183703	Modelling and Simulation	2+1 SWS	Lecture / Practice (VÜ)	Nestler
WS 19/20	2183703	Numerical methods and simulation techniques	3 SWS	Lecture / Practice (VÜ)	Nestler
Exams					
SS 2019	76-T-MACH-100300	Modelling and Simulation		Prüfung (PR)	Nestler
WS 19/20	76-T-MACH-100300	Modelling and Simulation		Prüfung (PR)	Nestler

Competence Certificate
Written exam, 90 min

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Below you will find excerpts from events related to this course:

V Modelling and Simulation
2183703, SS 2019, 2+1 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

Slides and black board. The slides will be provided as a manuscript for the course.

Notes
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.

written examination: 90 minutes

Learning Content
The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

V **Numerical methods and simulation techniques** **Lecture / Practice (VÜ)**
2183703, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

Slides and black board. The slides will be provided as a manuscript for the course.

Notes

The course gives an introduction to modelling and simulation techniques.
The following topics are included:
- splines, interpolation methods, Taylor series
- finite difference method
- dynamical systems
- numerics of partial differential equations
- mass and heat diffusion
- microstructure simulation
- parallel and adaptive algorithms
- high performance computing
- practical exercises

The student can

- explain the basic algorithms and numerical methods which are beside other applications relevant for materials simulations.
- describe and apply numerical solution methods for partial differential equations and dynamical systems
- apply numerical methods to solve heat and mass diffusion problems which can also be used to model microstructure formation processes
- has experiences in how to implement and program the introduced numerical methods from an integrated computer lab.

preliminary knowlegde in mathematics, physics and materials science recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. In addition, the course will be accompanied by practical exercises at the computer.

written examination: 90 minutes

Learning Content

The course gives an introduction to modelling and simulation techniques.

The following topics are included:

- polynom interpolation methods, splines, Taylor series
- zero point algorithms
- regression methods
- numerical differentiation and integration
- finite difference method
- dynamical systems, ordinary partial differential equations
- numerics of partial differential equations
- mass and heat diffusion equation
- computer lab in the programming language C, practical exercises

In parallel to the lecture, regular exercise sheets are provided and discussed. In addition, the course will be accompanied by practical exercises at the computer. Precondition to register for the written exam is the successful participation in the accompanying computer lab by presenting the solved excercise sheets at the PC.

Workload

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Scientific Computing, G. Golub and J.M. Ortega (B.G.Teubner Stuttgart 1996)

T 3.234 Course: Modelling of Microstructures [T-MACH-105303]

Responsible: Dr. Anastasia August
Prof. Dr. Britta Nestler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	2

Events					
WS 19/20	2183702	Modelling of Microstructures	3 SWS	Lecture / Practice (VÜ)	August, Nestler
Exams					
SS 2019	76-T-MACH-105303	Modelling of Microstructures		Prüfung (PR)	August, Nestler, Weygand

Competence Certificate
oral exam 30 min

Prerequisites
none

Recommendation
materials science
fundamental mathematics

Below you will find excerpts from events related to this course:

V Modelling of Microstructures
2183702, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

Black board and slides.

Notes

- Brief Introduction in thermodynamics
- Statistical interpretation of entropy
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Gibbs-Thomson-equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- For compare: Free energy functional with driving forces

The student can

- explain the thermodynamic and statistical foundations for liquid-solid and solid-solid phase transition processes and apply them to construct phase diagrams.
- describe the specific characteristics of dendritic, eutectic and peritectic microstructures.
- explain the mechanisms of grain and phase boundary motion induced by external fields
- use the phase-field method for simulation of microstructure formation processes using modeling approaches and challenges of current research
- has experiences in computing and conduction simulations of microstructure formation from an integrated computer lab.

knowledge in materials science and in fundamental mathematics recommended

regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

We regularly hand out exercise sheets. The individual solutions will be corrected.

oral exam ca. 30 min

Learning Content

- Brief Introduction in thermodynamics
- Statistical interpretation of entropy
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Gibbs-Thomson-equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- For compare: Free energy functional with driving forces

Workload
regular attendance: 22,5 hours lecture, 11,5 hours exercises
self-study: 116 hours

Literature

1. Gottstein, G. (2007) Physikalische Grundlagen der Materialkunde. Springer Verlag Berlin Heidelberg
2. Kurz, W. and Fischer, D. (1998) Fundamentals of Solidification. Trans Tech Publications ltd, Switzerland Germany UK USA
3. Porter, D.A. Eastering, K.E. and Sherif, M.Y. (2009) Phase transformation in metals and alloys (third edition). CRC Press, Taylor & Francis Group, Boca Raton, London, New York
4. Gaskell, D.R., Introduction to the thermodynamics of materials
5. Problem sheets

3.235 Course: Modern Control Concepts I [T-MACH-105539]

Responsible: Dr. Lutz Groell
PD Dr.-Ing. Jörg Matthes

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2105024	Modern Control Concepts I	2 SWS	Lecture (V)	Matthes, Groell
Exams					
SS 2019	76-T-MACH-105539	Modern Control Concepts I		Prüfung (PR)	Matthes

Competence Certificate
Written exam (Duration: 1 h)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Modern Control Concepts I
2105024, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

1. Introduction (classification, overviews, model simplification)
2. Simulation and analysis of dynamical systems with Matlab
3. Linearisation (equilibrium manifold, low-delta-method, Hartman-Grobman-theorem, design methodology for linear setpoint controller)
4. Two-degree-of-freedom control (structure, reference signal design)
5. PID-Controller (practical realisation, design hints, anti-windup-methods, Smith-predictor, switching technics, complex example)
6. Multi variable control and advanced control structures
7. State space (geometric view, role of zeros)
8. Tracking control with state feedback and supplemental integrator
9. Observer (LQG-design, disturbance observer, reduced observer)
10. Limits of control (existence subject, limits in time and frequency domain)

Recommendations:

Measurement and control systems

Learning objectives:

After completion this lecture, the students are able

- to analyse linear systems with respect to different properties,
- to design linear feedback systems with feedforward add-on in time and frequency domain under consideration of input saturation, time delay, unmeasurable states and couplings between system parts,
- to use Matlab for simulation, analysis and synthesis in numerical and computeralgebraic way,
- to realise controllers per software in practice

Learning Content

1. Introduction (classification, overviews, model simplification)
2. Simulation and analysis of dynamical systems with Matlab
3. Linearisation (equilibrium manifold, low-delta-method, Hartman-Grobman-theorem, design methodology for linear setpoint controller)
4. Two-degree-of-freedom control (structure, reference signal design)
5. PID-Controller (practical realisation, design hints, anti-windup-methods, Smith-predictor, switching technics, complex example)
6. Multi variable control and advanced control structures
7. State space (geometric view, role of zeros)
8. Tracking control with state feedback and supplemental integrator
9. Observer (LQG-design, disturbance observer, reduced observer)
10. Limits of control (existence subject, limits in time and frequency domain)

Workload

General attendance: 21 h

Self-study: 99 h

Literature

- Aström, K.-J., Murray, R.M.: Feedback Systems, 2012
- Rugh, W.: Linear System Theory. Prentice Hall, 1996

T 3.236 Course: Motor Vehicle Labor [T-MACH-105222]

Responsible: Dr.-Ing. Michael Frey
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each term	3

Events					
SS 2019	2115808	Motor Vehicle Laboratory	2 SWS	Practical course (P)	Frey, Knoch
WS 19/20	2115808	Motor Vehicle Laboratory	2 SWS	Practical course (P)	Frey, Knoch
Exams					
SS 2019	76-T-MACH-105222	Motor Vehicle Labor		Prüfung (PR)	Frey, Unrau

Competence Certificate
Colloquium before each experiment

After completion of the experiments: written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Motor Vehicle Laboratory

2115808, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle

2. Investigation of a twin-tube and a single-tube shock absorber

3. Behavior of car tyres under longitudinal forces and lateral forces

4. Behavior of car tires on wet road surface

5. Rolling resistance, energy dissipation and high-speed strength of car tires

6. Investigation of the moment transient characteristic of a Visco clutch

Workload
regular attendance: 31,5 hours
self-study: 103,5 hours

Literature
1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998

2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992

3. Gnadler, R.: Documents to the Motor Vehicle Laboratory

V Motor Vehicle Laboratory

2115808, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content

1. Determination of the driving resistances of a passenger vehicle on a roller dynamometer; measurement of the engine performance of the test vehicle

2. Investigation of a twin-tube and a single-tube shock absorber

3. Behavior of car tyres under longitudinal forces and lateral forces

4. Behavior of car tires on wet road surface

5. Rolling resistance, energy dissipation and high-speed strength of car tires

6. Investigation of the moment transient characteristic of a Visco clutch

Workload

regular attendance: 31,5 hours
self-study: 103,5 hours

Literature

1. Matschinsky, W: Radführungen der Straßenfahrzeuge, Verlag TÜV Rheinland, 1998

2. Reimpell, J.: Fahrwerktechnik: Fahrzeugmechanik, Vogel Verlag, 1992

3. Gnadler, R.: Documents to the Motor Vehicle Laboratory

T 3.237 Course: Multi-Scale Plasticity [T-MACH-105516]

Responsible: Dr. Christian Greiner
Dr. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Examination of another type	4	Each winter term	2

Events					
WS 19/20	2181750	Multi-scale Plasticity	2 SWS	Lecture (V)	Schulz, Greiner
Exams					
SS 2019	76-T-MACH-105516	Multi-Scale Plasticity		Prüfung (PR)	Schulz

Competence Certificate
presentation (40%) und colloquium (30 min, 60%)

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics, mechanics and materials science

Annotation

- limited number of participants
- mandatory registration
- mandatory attendance

Below you will find excerpts from events related to this course:

V Multi-scale Plasticity

2181750, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

black board, beamer, script

Notes
This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed.
This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

The student

- can explain the physical foundations of plasticity as well as results of latest research.
- can independently read and evaluate scientific research papers.
- can present specific, technical information in structured, precise, and readable manner.
- is able to argue for and/or against a particular approach or idea using the knowledge acquired within the lecture.

preliminary knowlegde in mathematics, physics, mechanics and materials science recommended

regular attendance: 22,5 hours
self-study: 97,5 hours

Exam: presentation (40%), oral examination (30 min, 60%)

Learning Content
This module will attempt to provide an overview to complex subjects in the field of material mechanics. For this purpose important scientific papers will be presented and discussed.
This will be done by having students read and critique one paper each week in a short review. In addition, each week will include presentation from one of the participants which aim to advocate or criticise each piece of work using the short reviews. He will also be the discussion leader, while students discuss the content, ideas, evaluation and open research questions of the paper. Using a professional conference management system (HotCRP), the student assume the role of reviewers and gain insight into the work of researchers.

Annotation
The maximum number of students is 14 per semester.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

T 3.238 Course: Nanotechnology for Engineers and Natural Scientists [T-MACH-105180]

Responsible: Prof. Dr. Martin Dienwiebel
PD Dr. Hendrik Hölscher
Stefan Walheim

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2142861	Nanotechnology for Engineers and Natural Scientists	2 SWS	Lecture (V)	Hölscher, Dienwiebel, Walheim
Exams					
SS 2019	76-T-MACH-105180	Nanotechnology for Engineers and Natural Scientists		Prüfung (PR)	Hölscher, Dienwiebel
WS 19/20	76-T-MACH-105180	Nanotechnology for Engineers and Natural Scientists		Prüfung (PR)	Hölscher, Dienwiebel

Competence Certificate
written exam 90 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nanotechnology for Engineers and Natural Scientists
Lecture (V)
2142861, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
1) Introduction into nanotechnology
2) History of scanning probe techniques
3) Scanning tunneling microscopy (STM)
4) Atomic force microscopy (AFM)
5) Dynamic Modes (DFM, ncAFM, MFM, KPFM, ...)
6) Friction force microscopy & nanotribology
7) Nanolithography
8) Other families of the SPM family

The student can

- explain the most common measurement principles of nanotechnology especialy scanning probe methods and is able to use them for the characterisation of chemical and physical properties of surfaces
- decribe interatomic forces and their influence on nanotechnology
- describe methods of micro- and nanofabrication and of –nanolithography
- explain simple models used in contact mechanics and nanotribology
- describe basic concepts used for nanoscale components

preliminary knowlegde in mathematics and physics

lectures 30 h

self study 30 h

preparation for examination 30 h

The successfull attandence of the lecture is controlled by a 30 minutes written examination, and a subsequent oral examination (20 min). Passing the written exam is mandantory for the participation of the oral examination. The grade result is the result of the oral exam.

Learning Content
1) Introduction into nanotechnology
2) History of scanning probe techniques
3) Scanning tunneling microscopy (STM)
4) Atomic force microscopy (AFM)
5) Dynamic Modes (DFM, ncAFM, MFM, KPFM, ...)
6) Friction force microscopy & nanotribology
7) Nanolithography
8) Other families of the SPM family

Workload
lectures 30 h

self study 30 h

preparation for examination 30 h

Literature

1. Lecture notes, slides, script
2. Scanning Probe Microscopy – Lab on a Tip: Meyer, Hug, Bennewitz, Springer (2003)

T 3.239 Course: Neurovascular Interventions (BioMEMS V) [T-MACH-106747]

Responsible: Dr.-Ing. Giorgio Cattaneo
Prof. Dr. Andreas Guber

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141103	BioMEMS V - Microfuidic Chip Systems	2 SWS	Lecture (V)	Rajabi, Guber
Exams					
SS 2019	76-T-MACH-106747	Neurovascular Interventions (BioMEMS V)		Prüfung (PR)	Guber

Competence Certificate
oral exam (30 Min.)

Prerequisites
none

T 3.240 Course: Neutron Physics of Fusion Reactors [T-MACH-105435]

Responsible: Dr. Ulrich Fischer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189473	Neutron physics of fusion reactors	2 SWS	Lecture (V)	Fischer
Exams					
SS 2019	76-T-MACH-105435	Neutron Physics of Fusion Reactors		Prüfung (PR)	Stieglitz, Fischer
WS 19/20	76-T-MACH-105435	Neutron physics of fusion reactors		Prüfung (PR)	Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Annotation
none

Below you will find excerpts from events related to this course:

V Neutron physics of fusion reactors

2189473, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Nuclear interaction processes and energy release
Chain reaction and criticality
Neutron transport, Boltzmann equation
Diffusion approximation, Monte Carlo method
Neutronic reactor design

The aim of this lecture is to provide the neutron physics principles required for analysis of nuclear fission and fusion reactors. First of all, the basic nuclear interaction processes are presented which are important for the physical behaviour of the reactors. Next the neutron transport phenomenon in matter is described by means of the Boltzmann transport equation. Suitable mathematical solution methods are presented such as the diffusion approximation for nuclear fission reactors and the Monte Carlo method for fusion reactors. The knowledge acquired will eventually be used to solve neutron physics problems related to the design and optimization of the reactors.

oral exam, duration: approximately 30 minutes, no tools or reference materials may be used during the exam

regular attendance: 21 h
self-study: 42 h

Admission to Campus North is required, please register to attend the lecture at: il-sekretariat@inr.kit.edu

Learning Content
Nuclear interaction processes and energy release

Chain reaction and criticality

Neutron transport, Boltzmann equation

Diffusion approximation, Monte Carlo method

Neutronic reactor design

Workload
regular attendance: 21 h
self-study: 42 h

Literature
K. H. Beckurts, K. Wirtz, Neutron Physics, Springer Verlag, Berlin, Germany (1964)

W. M. Stacey, Nuclear Reactor Physics, John Wiley & Sons, Wiley-VCH, Berlin(2007)

J. Raeder (Ed.), Kontrollierte Kernfusion. Grundlagen ihrer Nutzung zur Energieversorgung, Teubner, Stuttgart (1981)

T 3.241 Course: NMR micro probe hardware conception and construction [T-MACH-108407]

Responsible: Prof. Dr. Jan Gerrit Korvink
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2142551	NMR micro probe hardware conception and construction	2 SWS	Practical course (P)	Korvink, Jouda

Competence Certificate
Successful participation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V NMR micro probe hardware conception and construction

2142551, SS 2019, 2 SWS, Language: English, Open in study portal

Practical course (P)

Description
The aim of this practical block course is to familiarize the students with magnetic resonance imaging as a substantial non-invasive non-destructive imaging technique that is widely used for medical diagnosis.

It is also to give them hands-on experience on how to build the MRI probe from A to Z including

- Mechanical design
- High frequency electrical circuitry
- Testing on a commercial MRI scanner

Learning Content
In order to prepare attendees, the following chapters will be offered, spread over the week as lecture units, and accompanying the practical work:

- Theory of magnetic resonance imaging

-The MRI probe and the principle of reciprocity

- RF resonators

- Coaxial cables and cable traps

- Tuning and matching the MRI probe

- Effects of material susceptibility

- The mechanical support of the MRI probe

- Introduction to ParaVision, the MRI imaging software.

T 3.242 Course: Nonlinear Continuum Mechanics [T-MACH-105532]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	5	Each summer term	2

Events					
SS 2019	2162344	Nonlinear Continuum Mechanics	2 SWS	Lecture (V)	Böhlke

Competence Certificate
oral examination (approx. 25 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nonlinear Continuum Mechanics
2162344, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content

- tensor calculus, kinematics, balance equations
- principles of material theory
- finite elasticity
- infinitesimal elasto(visco)plasticity
- exact solutions ov infinitesimal Platicity
- finite elasto(visco)plasticity
- infinitesimal and finite crystal(visco)plasticity
- hardening and failure
- strain localization

Workload
regular attendance: 31,5 hours
self-study: 118 hours

Literature
lecture notes

Bertram, A.: Elasticity and Plasticity of Large Deformations - an Introduction. Springer 2005.
Liu, I-S.: Continuum Mechanics. Springer 2002.
Schade, H.: Tensoranalysis.Walter de Gruyter 1997.
Wriggers, P.: Nichtlineare Finite-Element-Methoden. Springer 2001.

T 3.243 Course: Novel Actuators and Sensors [T-MACH-102152]

Responsible: Prof. Dr. Manfred Kohl
Dr. Martin Sommer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	3

Events					
WS 19/20	2141865	Novel actuators and sensors	2 SWS	Lecture (V)	Kohl, Sommer

Competence Certificate
written exam, 60 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Novel actuators and sensors
2141865, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Script / script of ppt foils (part 2)

Learning Content
Contents: - Basic knowledge in the material science of actuator and sensor principles

- Layout and design optimization

- Fabrication technologies

- Selected developments

- Applications

Index: The lecture includes amongst others the following topics:

- Piezo actuators
- Magnetostrictive actuators
- Shape memory actuators
- Electro-/magnetorheological actuators
- Sensors: Concepts, materials, fabrication
- Micromechanical sensors: Pressure, force, inertia sensors
- Temperature sensors
- Micro sensors for bio analytics
- Mechano-magnetic sensors

The lecture addresses students in the fields of mechanical engineering, mechatronics and information technology, materials science and engineering, electrical engineering and economic sciences. A comprehensive introduction is given in the basics and current developments on the macroscopic length scale.

The lecture is core subject of the major course "Actuators and Sensors" of the specialization "Mechatronics and Microsystems Technology" in Mechanical Engineering.

Workload

Work Lecture:

time of attendance: 21 hours

Self-study: 99 hours

Literature

- Lecture notes
- Donald J. Leo, Engineering Analysis of Smart Material Systems, John Wiley & Sons, Inc., 2007
- "Sensors Update", Edited by H.Baltes, W. Göpel, J. Hesse, VCH, 1996, ISBN: 3-527-29432-5
- "Multivariate Datenanalyse – Methodik und Anwendungen in der Chemie", R. Henrion, G. Henrion, Springer 1994, ISBN 3-540-58188-X

T 3.244 Course: Nuclear Power Plant Technology [T-MACH-105402]

Responsible: Dr. Aurelian Florin Badea
Prof. Dr.-Ing. Xu Cheng
Prof. Dr.-Ing. Thomas Schulenberg

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2170460	Nuclear Power Plant Technology	2 SWS	Lecture (V)	Cheng, Schulenberg
Exams					
SS 2019	76-T-MACH-105402	Nuclear Power Plant Technology		Prüfung (PR)	Cheng, Schulenberg

Competence Certificate
oral exam, Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Nuclear Power Plant Technology
Lecture (V)

2170460, SS 2019, 2 SWS, Language: English, Open in study portal

Description
Powerpoint presentations

PWR simulator

BWR simulator

Notes
The training objective of the course is the qualification for a research-related professional activity in nuclear power plant engineering. The participants can describe the most important components of nuclear power plants and their function. You can design or modify nuclear power plants independently and creatively. They have acquired a broad knowledge of this power plant technology, including specific knowledge of core design, design of primary and secondary systems, and of nuclear safety technologies. Based on the acquired knowledge in thermodynamics and neutron physics, they can describe and analyze the specific behavior of the nuclear power plant components and assess risks. Participants of the lecture have a trained analytical thinking and judgment in the design of nuclear power plants.

Power plants with pressurized water reactors:

Design of the pressurized water reactor

- Fuel assemblies
- Control rods and drives
- Core instrumentation
- Reactor pressure vessel and its internals

Components of the primary system

- Primary coolant pumps
- Pressurizer
- Steam generator
- Water make-up system

Secondary system:

- Turbines
- Reheater
- Feedwater system
- Cooling systems

Containment

- Containment design
- Components of safety systems
- Components of residual heat removal systems

Control of a nuclear power plant with PWR

Power plants with boiling water reactors:

Design of the boiling water reactor

- Fuel assemblies
- Control elements and drives
- Reactor pressure vessel and its internals

Containment and components of safety systems

Control of a nuclear power plant with boiling water reactors

Learning Content
Power plants with pressurized water reactors:

Design of the pressurized water reactor

- Fuel assemblies
- Control rods and drives
- Core instrumentation
- Reactor pressure vessel and its internals

Components of the primary system

- Primary coolant pumps
- Pressurizer
- Steam generator
- Water make-up system

Secondary system:

- Turbines
- Reheater
- Feedwater system
- Cooling systems

Containment

- Containment design
- Components of safety systems
- Components of residual heat removal systems

Control of a nuclear power plant with PWR

Power plants with boiling water reactors:

Design of the boiling water reactor

- Fuel assemblies
- Control elements and drives
- Reactor pressure vessel and its internals

Containment and components of safety systems

Control of a nuclear power plant with boiling water reactors

Annotation
Recommendations:

Knowledge of thermodynamics are a mandatory requirement for this course.

Basic knowledge of the physics of nuclear fission wiill be helpful.

Simulator exercises with a simplified pressurized water reactor and a simplified boiling water reactor are offered to ease understanding of thermodynamics and neutron physics.

Workload
regular attendance: 48 h
self-study: 72 h

Literature
lecture notes

T 3.245 Course: Numerical Fluid Mechanics [T-MACH-105338]

Responsible: Dr.-Ing. Franco Magagnato
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2153441	Numerical Fluid Mechanics	2 SWS	Lecture (V)	Magagnato
Exams					
WS 19/20	76T-Mach-105338	Numerical Fluid Mechanics		Prüfung (PR)	Frohnapfel, Magagnato

Competence Certificate
oral exam - 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Numerical Fluid Mechanics

2153441, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

"Powerpoint presentation", Beamer

Notes
The students can describe the modern numerical simulation methods for fluid flows and can explain their relevance for industrial projects. They can choose appropriate boundary and initial conditions as well as turbulence models. They are qualified to explain the meaning of suitable meshes for processed examples. Convergence acceleration techniques like multi grid, implicit methods etc. as well as the applicability of these methods to parallel and vector computing can be described by the students. They can identify problems that occur during application of these methods and can discuss strategies to avoid them. The students are qualified to apply commercial codes like Fluent, Star-CD, CFX etc. as well as the research code SPARC. They can describe the differences between conventional methods (RANS) and more advanced approaches like Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS).

1. Governing Equations of Fluid Dynamics
2. Discretization
3. Boundary and Initial conditions
4. Turbulence Modelling
5. Mesh Generation
6. Numerical Methods
7. LES, DNS and Lattice Gas Methods
8. Pre- and Postprocessing
9. Examples of Numerical Methods for Industrial Applications

Learning Content
1. Governing Equations of Fluid Dynamics
2. Discretization
3. Boundary and Initial conditions
4. Turbulence Modelling
5. Mesh Generation
6. Numerical Methods
7. LES, DNS and Lattice Gas Methods
8. Pre- and Postprocessing
9. Examples of Numerical Methods for Industrial Applications

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
Ferziger, Peric: Computational Methods for Fluid Dynamics. Springer-Verlag, 1999.
Hirsch: Numerical Computation of Internal and External Flows. John Wiley & Sons Inc., 1997.
Versteg, Malalasekera: An introduction to computational fluid dynamics. The finite volume method. John Wiley & Sons Inc., 1995

T 3.246 Course: Numerical Fluid Mechanics with MATLAB [T-MACH-105453]

Responsible: Prof. Dr.-Ing. Bettina Frohnapfel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2154409	Numerical Fluid Mechanics with MATLAB	2 SWS	Practical course (P)	Stroh, Gatti, Frohnapfel
Exams					
SS 2019	76-T-MACH-105453	Numerical Fluid Mechanics with MATLAB		Prüfung (PR)	Frohnapfel, Gatti

Competence Certificate
ungraded homework

Prerequisites
none

Below you will find excerpts from events related to this course:

V Numerical Fluid Mechanics with MATLAB
2154409, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

Power Point, workstations: independent programming

Learning Content
Numerical Fluid Mechanics with Matlab

- Introduction to Numerics and Matlab
- Finite-Difference-Method
- Finite-Volume-Method
- boundary conditions and intial conditions
- explicit and implicite schemes
- pressure correction

Annotation
Block course with limited number of participants, registration in the secretary's office required. See details at www.istm.kit.edu

Workload
attendance: 20h

self-study: 100h

Literature
H. Ferziger, M. Peric, *Computational Methods for Fluid Dynamics*, Springer, 2008

T 3.247 Course: Numerical Mathematics for Students of Computer Science [T-MATH-102242]

Responsible: Prof. Dr. Andreas Rieder
Dr. Daniel Weiß
Prof. Dr. Christian Wieners

Organisation: KIT Department of Mathematics

Part of: M-MACH-104885 - Courses of the Department of Mathematics

Type	Credits	Recurrence	Version
Written examination	6	Each term	3

Events					
SS 2019	0187400	Numerische Mathematik für die Fachrichtungen Informatik und Ingenieurwesen	2 SWS	Lecture (V)	Weiß
SS 2019	0187500	Übungen zu 0187400	1 SWS	Practice (Ü)	Weiß
Exams					
SS 2019	770100085	Numerical Mathematics for Students of Computer Science		Prüfung (PR)	Weiß

Prerequisites
None

T 3.248 Course: Numerical Mechanics for Industrial Applications [T-MACH-108720]

Responsible: Prof. Dr. Eckart Schnack
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2162298	Numerical mechanics for industrial applications	3 SWS	Lecture (V)	Schnack
Exams					
SS 2019	76-T-MACH-108720	Numerical Mechanics for Industrial Applications		Prüfung (PR)	

Competence Certificate
Oral exam, 20 minutes

Prerequisites
None

Below you will find excerpts from events related to this course:

V Numerical mechanics for industrial applications

2162298, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
Brief overview of finite element methods. Structure of boundary element methods (BEM). Explanation of hybrid tension methods. Higher-grade finite element processes. Non-linear FEM processes.

Workload
Contact time: 33.75 hrs; Self-study: 127 hrs

T 3.249 Course: Numerical Simulation of Multi-Phase Flows [T-MACH-105420]

Responsible: Dr. Martin Wörner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2130934	Numerical Modeling of Multiphase Flows	2 SWS	Lecture (V)	Wörner
Exams					
SS 2019	76-T-MACH-105420	Numerical Simulation of Multi-Phase Flows		Prüfung (PR)	Frohnapfel

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Numerical Modeling of Multiphase Flows

2130934, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

1. Introduction in the subject of multi-phase flows (terms and definitions, examples)
2. Physical fundamentals (dimensionless numbers, phenomenology of single bubbles, conditions at fluid interfaces, forces on a suspended particle)
3. Mathematical fundamentals (governing equations, averaging, closure problem)
4. Numerical fundamentals (discretization in space and time, truncation error and numerical diffusion)
5. Models for interpenetrating continua (homogeneous model, algebraic slip model, standard two-fluid model and its extensions)
6. Euler-Lagrange model (particle equation of motion, particle response time, one-/two-/four-way coupling)
7. Interface resolving methods (volume-of-fluid, level-set and front-capturing method)

Annotation
For some topics of the lecture exercises are provided (working on them is optional).

Workload
regular attendance: 21h

self-study: 99h

Literature
A brief script can be downloaded from http://bibliothek.fzk.de/zb/berichte/FZKA6932.pdf.

Powerpoint presentations can be downloaded after each lecture from the ILIAS system.

A list of recommended books is provided in the first lecture.

T 3.250 Course: Numerical Simulation of Turbulent Flows [T-MACH-105397]

Responsible: Dr. Günther Grötzbach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2153449	Numerical Simulation of Turbulent Flows	3 SWS	Lecture (V)	Grötzbach
Exams					
SS 2019	76-T-MACH-105397	Numerical Simulation of Turbulent Flows		Prüfung (PR)	Grötzbach

Competence Certificate
oral

Duration: 30 minutes

no auxiliary means

Prerequisites
none

Recommendation
Basics in fluid mechanics

Below you will find excerpts from events related to this course:

V Numerical Simulation of Turbulent Flows
2153449, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

black board, plus pictures, movies, and script in English (distributed chapter by chapter)

Notes
The students are qualified to describe the fundamentals of direct numerical simulation (DNS) and large eddy simulation (LES) of turbulent flows. They understand the principle differences between these simulation methods and the respective properties of the conventional turbulence modelling approaches basing on Reynolds Averaged Navier-Stokes equations (RANS). They can describe subgrid scale models, peculiarities of wall and inlet/outlet modelling, suitable numerical solution schemes and evaluation methods. They have obtained the knowledge and understanding required to identify the best modelling approach (among the available methods) for the problem at hand, thus being able to solve given thermal and fluid dynamical problems appropriately.

The lecture series will introduce in following subjects of the turbulence simulation method:

- Appearance of turbulence and deduction of requirements and limits of the simulation method.
- Conservation equations for flows with heat transfer, filtering them in time or space.
- Some subgrid scale models for small scale turbulence and their physical justification.
- Peculiarities in applying boundary and initial conditions.
- Suitable numerical schemes for integration in space and time.
- Statistical and graphical methods to analyse the simulation results.
- Application examples for turbulence simulations in research and engineering

Learning Content
The lecture series will introduce in following subjects of the turbulence simulation method:

- Appearance of turbulence and deduction of requirements and limits of the simulation method.
- Conservation equations for flows with heat transfer, filtering them in time or space.
- Some subgrid scale models for small scale turbulence and their physical justification.
- Peculiarities in applying boundary and initial conditions.
- Suitable numerical schemes for integration in space and time.
- Statistical and graphical methods to analyse the simulation results.
- Application examples for turbulence simulations in research and engineering

Annotation
Recommendations: basics in fluid mechanics

Workload
regulare attendance: 29h

self-study: 91h

Literature
J. Piquet, *Turbulent Flows – Models and Physics,* Springer, Berlin (2001)

J. Fröhlich, *Large Eddy Simulation turbulenter Strömungen.* Lehrbuch Maschinenbau, B.G. Teubner Verlag, Wiesbaden (2006)

P. Sagaut, C. Meneveau, *Large-eddy simulation for incompressible flows: An introduction.* Springer Verlag (2010)

G. Grötzbach, *Revisiting the Resolution Requirements for Turbulence Simulations in Nuclear Heat Transfer.* Nuclear Engineering & Design Vol. 241 (2011) pp. 4379-4390

G. Grötzbach,Script in English

T 3.251 Course: Occupational Safety and Environmental Protection [T-MACH-105386]

Responsible: Rainer von Kiparski
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2110037	Occupational Safety and Environmental Protection	2 SWS		von Kiparski
Exams					
SS 2019	76-T-MACH-105386	Occupational Safety and Environmental Protection		Prüfung (PR)	Deml

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
none

Below you will find excerpts from events related to this course:

V Occupational Safety and Environmental Protection
2110037, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
The participants have to solve a specific case study within the field of occupational safety and environmental protection. Therefore, they work in a team. The course work covers the information research as well as the presentation of the results.

Content:

- Occupational Safety and Safety Engineering
- Environmental Protection within a Production Enterprise
- Health Management

Structure:

- Terminology
- Basics of Occupational Safety and Environmental Protection
- Case Study
- Moderated Processing of a Case Stuy within a Small Group

Learning Content
The participants have to solve a specific case study within the field of occupational safety and environmental protection. Therefore, they work in a team. The course work covers the information research as well as the presentation of the results.

Content:

- Occupational Safety and Safety Engineering
- Environmental Protection within a Production Enterprise
- Health Management

Structure:

- Terminology
- Basics of Occupational Safety and Environmental Protection
- Case Study
- Moderated Processing of a Case Stuy within a Small Group

Workload
Compact course (one week full-time).

The amount of work accounts for 120 h (=4 ECTS).

Literature
Handout and literature are available on ILIAS for download.

T 3.252 Course: Organ Support Systems [T-MACH-105228]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2106008	Organ support systems	2 SWS	Lecture (V)	Pylatiuk
Exams					
SS 2019	76-T-MACH-105228	Organ Support Systems		Prüfung (PR)	Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Organ support systems
2106008, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

Learning objectives:

Students have fundamental knowledge about functionality of organ support systems and its components. An analysis of historical developments can be done and limitations of current systems can be found. The limits and possibilities of transplantations can be elaborated.

Learning Content

- Introduction: Definitions and classification of organ support and replacement.
- Special topics: acoustic and visual prostheses, exoskeletons, neuroprostheses, tissue-engineering, hemodialysis, heart-lung machine, artificial hearts, biomaterials.

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Jürgen Werner: Kooperative und autonome Systeme der Medizintechnik: Funktionswiederherstellung und Organersatz. Oldenbourg Verlag.
- Rüdiger Kramme: Medizintechnik: Verfahren - Systeme – Informationsverarbeitung. Springer Verlag.
- E. Wintermantel, Suk-Woo Ha: Medizintechnik. Springer Verlag.

3.253 Course: Patent Law [T-INFO-101310]

Responsible: Prof. Dr. Thomas Dreier
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	2

Events					
SS 2019	24656	Patent Law	2 SWS	Lecture (V)	Koch
Exams					
SS 2019	7500062	Patent Law		Prüfung (PR)	Dreier, Matz
WS 19/20	7500001	Patent Law		Prüfung (PR)	Dreier, Matz

T 3.254 Course: Photovoltaics [T-ETIT-101939]

Responsible: Prof. Dr.-Ing. Michael Powalla
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	2

Events					
SS 2019	2313737	Photovoltaics	4 SWS	Lecture (V)	Powalla, Lemmer
Exams					
SS 2019	7313737	Photovoltaics		Prüfung (PR)	Powalla, Lemmer

Prerequisites
"M-ETIT-100524 - Solar Energy" must not have started.

T 3.255 Course: Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle [T-MACH-105537]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each winter term	2

Events					
WS 19/20	2189906	Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle	1 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle

Lecture (V)

2189906, WS 19/20, 1 SWS, Language: German, Open in study portal

Notes

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima .
- Fission , chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

The students

- understand the physical explanations of the known nuclear accidents
- can perform simplified calculations to demonstrate the accidents outcome.
- Define safety relevant properties of low/ intermediate / high level waste products
- Are able to evaluate principles and implications of reprocessing, storage and disposal options for nuclear waste.

Regular attendance: 14 h
self study 46 h
oral exam about 20 min.

Learning Content

- Relevant physical terms of nuclear physics
- Decay heat removal- Borst-Wheeler equation
- The accidents in TMI- Three Mile Island, and Fukushima .
- Fission , chain reaction and reactor control systems
- Basics of nuclear cross sections
- Principles of reactor dynamics
- Reactor poisoning
- The Idaho and Chernobyl accidents
- Principles of the nuclear fuel cycle
- Reprocessing of irradiated fuel elements and vitrification of fission product solutions
- Interim storage of nuclear residues in surface facilities
- Multi barrier concepts for final disposal in deep geological formations
- The situation in the repositories Asse II, Konrad and Morsleben

Workload
Regular attendance: 14 h
self study 46 h

Literature
AEA- Open documentation of the reactor accidents
K. Wirtz: Basics of Reactor technic Par I, II, Technic School Karlsruhe 1966 (in German)
D. Emendorfer. K.H. Höcker: Theory of nuclear reactions, Parts I, II BI- Hochschultaschenbücher 1969 (in German)
J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley $ Sons , Inc. 1975.
R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006
J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006

T 3.256 Course: Physical Basics of Laser Technology [T-MACH-102102]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	5	Each winter term	3

Events					
WS 19/20	2181612	Physical basics of laser technology	3 SWS	Lecture / Practice (VÜ)	Schneider
Exams					
SS 2019	76-T-MACH-102102	Physical Basics of Laser Technology		Prüfung (PR)	Schneider
WS 19/20	76-T-MACH-102102	Physical Basics of Laser Technology		Prüfung (PR)	Schneider

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with brick Laser Application in Automotive Engineering [T-MACH-105164] and brick Physical Basics of Laser Technology [T-MACH-109084]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105164 - Laser in Automotive Engineering must not have been started.

Recommendation
Basic knowledge of physics, chemistry and material science

Below you will find excerpts from events related to this course:

V Physical basics of laser technology

2181612, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Description
Media:

lecture notes via ILIAS

Notes

Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- savety aspects

The lecture is complemented by a tutorial.

The student

- can explain the principles of light generation, the conditions for light amplification as well as the basic structure and function of different laser sources.
- can describe the influence of laser, material and process parameters for the most important methods of laser-based materials processing and choose laser sources suitable for specific applications.
- can illustrate the possible applications of laser sources in measurement and medicine technology
- can explain the requirements for safe handling of laser radiation and for the design of safe laser systems.

Basic knowledge of physics, chemistry and material science is assumed.

regular attendance: 33,5 hours
self-study: 116,5 hours

The assessment consists of an oral exam (ca. 30 min) taking place at the agreed date (according to Section 4(2), 2 of the examination regulation). The re-examination is offered upon agreement.

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Learning Content

Based on the description of the physical basics about the formation and the properties of laser light the lecture goes through the different types of laser beam sources used in industry these days. The lecture focuses on the usage of lasers especially in materials engineering. Other areas like measurement technology or medical applications are also mentioned. An excursion to the laser laboratory of the Institute for Applied Materials (IAM) will be offered.

- physical basics of laser technology
- laser beam sources (solid state, diode, gas, liquid and other lasers)
- beam properties, guiding and shaping
- lasers in materials processing
- lasers in measurement technology
- lasers for medical applications
- savety aspects

The lecture is complemented by a tutorial.

Annotation

It is allowed to select only one of the lectures "Laser in automotive engineering" (2182642) or "Physical basics of laser technology" (2181612) during the Bachelor and Master studies.

Workload

regular attendance: 33,5 hours
self-study: 116,5 hours

Literature

W. T. Silfvast: Laser Fundamentals, 2008, Cambridge University Press

W. M. Steen: Laser Material Processing, 2010, Springer

T 3.257 Course: Polymer Engineering I [T-MACH-102137]

Responsible: Prof. Dr.-Ing. Peter Elsner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173590	Polymer Engineering I	2 SWS	Lecture (V)	Elsner, Liebig
Exams					
SS 2019	76-T-MACH-102137	Polymer Engineering I		Prüfung (PR)	Elsner
WS 19/20	76-T-MACH-102137	Polymer Engineering I		Prüfung (PR)	Elsner

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymer Engineering I
Lecture (V)
2173590, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end electrical properties
3. Processing of polymers
(introduction)
4. Material science of polymers
5. Synthesis

learning objectives:

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, to equip the students with knowledge and technical skills, and to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- are able to describe and classify polymers
  based on the fundamental synthesis processing techniques
- can find practical applications for state-of-the-art polymers and manufacturing technologies
- are able to apply the processing techniques, the application of polymers and polymer composites regarding to the basic principles of material science
- can describe the special mechanical, chemical and elctrical prooperties of polymers and correlate these properties to the chemical bindings.
- can define application areas and the limitation in the use of polymers

requirements:
none

workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content
1. Economical aspects of polymers
2. Introductiom of mechanical,
chemical end electrical properties
3. Processing of polymers
(introduction)
4. Material science of polymers
5. Synthesis

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
Recommended literature and selected official lecture notes are provided in the lecture

T 3.258 Course: Polymer Engineering II [T-MACH-102138]

Responsible: Prof. Dr.-Ing. Peter Elsner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2174596	Polymer Engineering II	2 SWS	Lecture (V)	Elsner
Exams					
SS 2019	76-T-MACH-102138	Polymerengineering II		Prüfung (PR)	Elsner
WS 19/20	76-T-MACH-102138	Polymerengineering II		Prüfung (PR)	Elsner

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Knowledge in Polymerengineering I

Below you will find excerpts from events related to this course:

V Polymer Engineering II

Lecture (V)

2174596, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

learning objectives:

The field of Polymer Engineering includes synthesis, material science, processing, construction, design, tool engineering, production technology, surface engineering and recycling. The aim is, that the students gather knowledge and technical skills to use the material "polymer" meeting its requirements in an economical and ecological way.

The students

- can describe and classify different processing techniques
  and can exemplify mould design principles based on technical parts.
- know about practical applications and processing of polymer parts
- are able to design polymer parts according to given restrictions
- can choose appropriate polymers based on the technical requirements
- can decide how to use polymers regarding the production, economical and ecological requirements

requirements:
Polymerengineering I
workload:

The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Learning Content
1. Processing of polymers
2. Properties of polymer components
Based on practical examples and components
2.1 Selection of material
2.2 Component design
2.3 Tool engineering
2.4 Production technology
2.5 Surface engineering
2.6 Sustainability, recycling

Workload
The workload for the lecture Polymerengineering II is 120 h per semester and consists of the presence during the lecture (21 h) as well as preparation and rework time at home (99 h).

Literature
Recommended literature and selected official lecture notes are provided in the lecture.

T 3.259 Course: Polymers in MEMS A: Chemistry, Synthesis and Applications [T-MACH-102192]

Responsible: Dr.-Ing. Bastian Rapp
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141853	Polymers in MEMS A: Chemistry, Synthesis and Applications	2 SWS		Rapp

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymers in MEMS A: Chemistry, Synthesis and Applications
2141853, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

The lecture slides will be given out as scriptum during each lecture course.

Learning Content

We all come in contact with numerous polymeric products in everyday life. From water bottles to packaging to the cover of the iPad, many things are made of polymers. Polymers are also important materials for modern microelectromechanical systems (MEMS) allowing cost effective mass market compatible products, e.g., in the life sciences or diagnostics. But polymers are not just cost-effective replacements for more expensive classical materials in MEMS (such as, e.g., silicon) – some polymers have intrinsic properties that make them ideal materials for sensors, actuators or templates for biology and chemistry in MEMS.

This lecture will introduce the basics of organic chemistry required for understanding what polymers are, how they are manufactured and which mechanisms are responsible for their unique properties. The lecture will highlight (in the context of MEMS but also in a wider scope) where and why polymers are applied with a strong focus on their chemical and physical properties (and on their synthesis).

Some of the topics covered are:

- What is the basic chemistry of polymers? What are monomers, what are macromolecules and how are they formed?
- How are polymers produced on industrial scale – but also on the laboratory scale? Numerous examples of how to make (commonly and lesser known) polymers will be discussed including materials such as Plexiglas.
- Why are polymers so important for biochemistry and tissue engineering?
- How do photoresists work and why do some polymers contract when exposed to light?
- What are high-performance polymers and why do they have such a wide application range, e.g., in implants?
- What polymers fuel the household 3D printing community and what materials do 3D printers such as, e.g., the RepRap work with?
- How does 3D printing and rapid prototyping work and which polymers can be employed for which techniques?
- Why does silicone always smell like vinegar and why is this material so important for modern day microfluidics? How do you built fluid-logic devices using silicone?
- How do shape memory polymers remember their shape?
- What are polymer foams and why are they not only important for heat insulation but also for organic chemistry?
- How do glues work? Why are there two-component glues, what is superglue and how can you make glue from potatoes?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu). Preregistration is not necessary.

The examination will be held in oral form at the end of the lecture. The lecture can be chosen as "Nebenfach" or part of a "Hauptfach". The second lecture of the lecture series "Polymers in MEMS B – Physics, manufacturing and applications" (which is also held in winter semester) can be combined with this lecture as part of a "Hauptfach". In summer semester, the third part of the lecture series "Polymers in MEMS C – Biopolymers, Biopolymers and applications" will be given which may be combined with lectures A and B to form a complete "Hauptfach".

Annotation

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu). Preregistration is not necessary.

Workload

- lecture: 15 * 1.5 h (22 h)
- lecture preparation (before and after lecture): 15 * 2 h (30 h)
- preparation of final exam: 70 h

T 3.260 Course: Polymers in MEMS B: Physics, Microstructuring and Applications [T-MACH-102191]

Responsible: Dr.Ing. Matthias Worgull
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2141854	Polymers in MEMS B: Physics, Microstructuring and Applications	2 SWS	Lecture (V)	Worgull
Exams					
SS 2019	76-T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications		Prüfung (PR)	Worgull

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymers in MEMS B: Physics, Microstructuring and Applications

2141854, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:
The lecture slides will be given out as scriptum during each lecture course.

Learning Content

We all come in contact with numerous polymeric products in everyday life. From water bottles to packaging to the cover of the iPad, many things are made of polymers. Polymers are also important materials for modern microelectromechanical systems (MEMS) allowing cost effective mass market compatible products, e.g., in the life sciences or diagnostics. But polymers are not just cost-effective replacements for more expensive classical materials in MEMS (such as, e.g., silicon) – some polymers have intrinsic properties that make them ideal materials for sensors, actuators or templates for biology and chemistry in MEMS.

This lecture will introduce the basics of physics and material science required for the understanding of the mechanical behavior seen from the engineers view. Micro and nanostructuring of polymers allows the fabrication of micro parts fulfilling their tasks in mostly invisible different applications. But also the fabrication of polymer parts with functional surfaces inspired from Bionics will be presented in this lesson. The lesson will give further an overview over the polymer based structuring processes and will underline the importance by a number of applications e.g. photonic structures or Lotus-like structures.

Some of the topics covered are:

- How can polymers described from the view of engineers?
- What are the differences between polymers and metals?
- Rheology of polymer melts – How does polymer melts flow?
- How can polymers be formed and demolded?
- Which structuring processes (replication) processes are available?
- How does stress influence molded parts (e.g. the deformation of a CD in a hot car)
- Shrinkage of polymers – which precision is achievable
- Gluing or welding – How can polymers be assembled?
- Simulation of replication processes
- Characterization of polymers – which properties can be measured?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

The examination will be held in oral form at the end of the lecture. The lecture can be chosen as "Nebenfach" or part of a "Hauptfach". The second lecture of the lecture series ""Polymers in MEMS A – Chemistry, synthesis and applications " (which is also held in winter semester) can be combined with this lecture as part of a "Hauptfach". In summer semester, the third part of the lecture series "Polymers in MEMS C – Biopolymers, Biopolymers and applications" will be given which may be combined with lectures A and B to form a complete "Hauptfach".

Annotation

For further details, please contact the lecturer, PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Workload

- lecture: 15 * 1.5 h (22 h)
- lecture preparation (before and after lecture): 15 * 2 h (30 h)
- preparation of final exam: 70 h

T 3.261 Course: Polymers in MEMS C: Biopolymers and Bioplastics [T-MACH-102200]

Responsible: Dr.-Ing. Bastian Rapp
Dr.Ing. Matthias Worgull

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2142855	Polymers in MEMS C - Biopolymers and Bioplastics	2 SWS		Worgull, Rapp
Exams					
SS 2019	76-T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics		Prüfung (PR)	Worgull, Rapp

Competence Certificate
Oral examination

Prerequisites
none

Below you will find excerpts from events related to this course:

V Polymers in MEMS C - Biopolymers and Bioplastics
2142855, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content

Polymers are ubiquitous in everyday life: from packaging materials all the way to specialty products in medicine and medical engineering. Today it is difficult to find a product which does not (at least in parts) consist of polymeric materials. The question of how these materials can be improved with respect to their disposal and consumption of (natural) resources during manufacturing is often raised. Today polymers must be fully recycled in Germany and many other countries due to the fact that they do not (or only very slowly) decompose in nature. Furthermore significant reductions of crude oil consumption during synthesis are of increasing importance in order to improve the sustainability of this class of materials. With respect to disposal polymers which do not have to be disposed by combustion but rather allow natural decomposition (composting) are of increasing interest. Polymers from renewable sources are also of interest for modern microelectromechanical systems (MEMS) especially if the systems designed are intended as single-use products.

This lecture will introduce the most important classes of these so-called biopolymers and bioplastics. It will also discuss and highlight polymers which are created from naturally created analogues (e.g. via fermentation) to petrochemical polymer precursors and describe their technical processing. Numerous examples from MEMS as well as everyday life will be given.

Some of the topics covered are:

- What are biopolyurethanes and how can you produce them from castor oil?
- What are "natural glues" and how are they different from chemical glues?
- How do you make tires from natural rubbers?
- What are the two most important polymers for life on earth?
- How can you make polymers from potatoes?
- Can wood be formed by injection molding?
- How do you make buttons from milk?
- Can you play music on biopolymers?
- Where and how do you use polymers for tissue engineering?
- How can you built LEGO with DNA?

The lecture will be given in German language unless non-German speaking students attend. In this case, the lecture will be given in English (with some German translations of technical vocabulary). The lecture slides are in English language and will be handed out for taking notes. Additional literature is not required.

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu) and PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Annotation

For further details, please contact the lecturer, Dr. Ing. Bastian E. Rapp (bastian.rapp@kit.edu) and PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Workload

- lecture: 15 * 1.5 h (22 h)
- lecture preparation (before and after lecture): 15 * 2 h (30 h)

preparation of final exam: 70 h

Literature

Additional literature is not required.

T 3.262 Course: Powertrain Systems Technology B: Stationary Machinery [T-MACH-105216]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2145150	Powertrain Systems Technology B: Stationary Machinery	2 SWS	Lecture (V)	Albers, Ott
Exams					
SS 2019	76-T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery		Prüfung (PR)	Albers, Ott

Competence Certificate
written examination: 60 min duration

Prerequisites
None

Below you will find excerpts from events related to this course:

V Powertrain Systems Technology B: Stationary Machinery

Lecture (V)

2145150, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Content

Students acquire the basic skills needed to develop future energy-efficient and safe drive system solutions for use in industrial environments. The course considers holistic development methods and evaluations of drive systems. The focal points can be divided into the following chapters:

- Powertrain System
- Operator System
- Environment System
- System Components
- Development Process

Recommendations:

- Powertrain Systems Technology A: Automotive Systems

T 3.263 Course: Practical Course Technical Ceramics [T-MACH-105178]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	1

Events					
WS 19/20	2125751	Practical Course Technical Ceramics	2 SWS	Practical course (P)	Schell
Exams					
WS 19/20	76-T-MACH-105178	Practical Course Technical Ceramics		Prüfung (PR)	Schell

Competence Certificate
Colloquium and laboratory report for the respective experiments.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Practical Course Technical Ceramics

2125751, WS 19/20, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
Based on alumina as a model material, major test methods for the characterization of raw materials, intermediate and final products are practically applied. Topics:

- powder caracterization
- Shaping of powder compacts
- sintering
- microstructural characterization
- mechanical testing

On the basis of short descriptions of the methods, the students prepare themselfes, carry out the experiments and write a laboratory report.

Workload
regular attendance: 30 hours
self-study: 90 hours

Literature
Salmang, H.: Keramik, 7. Aufl., Springer Berlin Heidelberg, 2007. - Online-Ressource

Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006

T 3.264 Course: Practical Training in Basics of Microsystem Technology [T-MACH-102164]

Responsible: Dr. Arndt Last
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	1

Events					
SS 2019	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
SS 2019	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
WS 19/20	2143875	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
WS 19/20	2143877	Introduction to Microsystem Technology - Practical Course	2 SWS	Practical course (P)	Last
Exams					
SS 2019	76-T-MACH-102164	Practical Training in Basics of Microsystem Technology		Prüfung (PR)	Last

Competence Certificate
The assessment consists of a written exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Introduction to Microsystem Technology - Practical Course

2143875, SS 2019, 2 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy

Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V **Introduction to Microsystem Technology - Practical Course** **Practical course (P)**
2143877, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V **Introduction to Microsystem Technology - Practical Course** **Practical course (P)**
2143875, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

V **Introduction to Microsystem Technology - Practical Course** **Practical course (P)**
2143877, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
In the practical training includes nine experiments:
1. Hot embossing of plastics micro structures
2. Micro electroforming
3. Mikro optics: "LIGA-micro spectrometer"
4. UV-lithography
5. Optical waveguides
6. Capillary electrophoresis on a chip
7. SAW gas sensor
8. Metrology
9. Atomic force microscopy
Each student takes part in only five experiments.
The experiments are carried out at real workstations at the IMT and coached by IMT-staff.

Workload
Time of attendance: 21 h + 2 h exam
Privat studies: 5 h preparing experiments + 10 h preparing the exam

T 3.265 Course: Practical Training in Measurement of Vibrations [T-MACH-105373]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	1

Events					
SS 2019	2162208	Schwingungstechnisches Praktikum	SWS	Practical course (P)	Fidlin, Aramendiz Fuentes
Exams					
SS 2019	7600020	Practical Training in Measurement of Vibrations		Prüfung (PR)	Fidlin

Competence Certificate
Colloquium to each session, 10 out of 10 colloquiums must be passed

Prerequisites
Can not be combined with Experimental Dynamics (T-MACH-105514).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105514 - Experimental Dynamics must not have been started.

Recommendation
Vibration Theory, Mathematical Methods of Vibration Theory, Dynamic Stability, Nonlinear Vibrations

T 3.266 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Responsible: Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture (V)	Schell
Exams					
SS 2019	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing		Prüfung (PR)	Schell
WS 19/20	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing		Prüfung (PR)	Schell

Competence Certificate
The assessment consists of an oral exam (20-30 min) taking place at the agreed date. The re-examination is offered upon agreement.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Basic principles of powder metallurgical and ceramic processing

Lecture (V)

2193010, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
The course covers fundamentals of the process technology for shaping of ceramic or metal particle systems. Important shaping methods are reviewed. The focus is on characterization and properties of particulate systems, and, in particular, on process technology for shaping of powders, pastes, and suspensions.

Workload
regular attendance: 25 hours
self-study: 95 hours

Literature

- R.J. Brook: Processing of Ceramics I+II, VCH Weinheim, 1996
- M.N. Rahaman: Cermamic Processing and Sintering, 2nd Ed., Marcel Dekker, 2003
- W. Schatt ; K.-P. Wieters ; B. Kieback. ".Pulvermetallurgie: Technologien und Werkstoffe", Springer, 2007
- R.M. German. "Powder metallurgy and particulate materials processing. Metal Powder Industries Federation, 2005
- F. Thümmler, R. Oberacker. "Introduction to Powder Metallurgy", Institute of Materials, 1993

T 3.267 Course: Principles of Medicine for Engineers [T-MACH-105235]

Responsible: Prof. Dr. Christian Pylatiuk
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2105992	Principles of Medicine for Engineers	2 SWS	Lecture (V)	Pylatiuk
Exams					
SS 2019	76-T-MACH-105235	Principles of Medicine for Engineers		Prüfung (PR)	Pylatiuk

Competence Certificate
Written examination (Duration: 45min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Principles of Medicine for Engineers

2105992, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Learning objectives:

Students have fundamental knowledge about functionality and anatomy of organs within different medical disciplines. The students further know about technical methods in diagnosis and therapy, common diseases, their relevance and costs. Finally the students are able to communicate with medical doctors in a way, in which they prevent misunderstandings and achieve a more realistic idea of each others expectations.

Learning Content

- Introduction: Definitions of "health" and "disease". History of medicine and paradigm shift towards evidence based medicine and personalized medicine.
- Special topics: nervous system, saltatory conduction, musculoskeletal system, cardio-circulatory system, narcosis, pain, respiratory system, sensory organs, gynaecology, digestive organs, surgery, nephrology, orthopaedics, immune system, genetics.

Annotation
Recommendations: Organ support systems

Workload
General attendance: 21 h

Self-study: 99 h

Literature

- Adolf Faller, Michael Schünke: Der Körper des Menschen. Thieme Verlag.
- Renate Huch, Klaus D. Jürgens: Mensch Körper Krankheit. Elsevier Verlag.

T 3.268 Course: Probability Theory and Statistics [T-MATH-109620]

Responsible: Prof. Dr. Daniel Hug
Organisation: KIT Department of Mathematics
Part of: M-MACH-104885 - Courses of the Department of Mathematics

Type	Credits	Recurrence	Version
Written examination	5	Each term	2

Exams				
SS 2019	7700012	Probability Theory and Statistics	Prüfung (PR)	Winter

Competence Certificate
Written exam (90 min.)

Prerequisites
None

T 3.269 Course: Process Simulation in Forming Operations [T-MACH-105348]

Responsible: Dr.-Ing. Dirk Helm
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2161501	Process Simulation in Forming Operations	2 SWS	Lecture (V)	Helm

Competence Certificate
oral exam, 20 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Process Simulation in Forming Operations
2161501, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Based on basics of continuum mechanics, material theory and numerics the lecture gives an introduction into the simulation of forming operations for metals

- plasticity for metallic materials: dislocations, twinning, phase transformations, aniostropy, hardening
- classification of forming operations and discussion of selected topics
- basics of tensor algebra and tensor analysis
- continuum mechanics: kinematics, finite deformations, balance laws, thermdydnamics
- material theory: basics, modelling concepts, plasticity and visco plasticity, yield functions (von Mises, Hill, ...), kinematic and isotropic hardening, damage
- thermomechanical coupling
- modelling of contact
- finite element method: explicit and implicite formulations, types of elements, numerical integration of material models
- process simulation of selected problems of sheet metal forming

Learning Content
Based on basics of continuum mechanics, material theory and numerics the lecture gives an introduction into the simulation of forming operations for metals

- plasticity for metallic materials: dislocations, twinning, phase transformations, aniostropy, hardening
- classification of forming operations and discussion of selected topics
- basics of tensor algebra and tensor analysis
- continuum mechanics: kinematics, finite deformations, balance laws, thermdydnamics
- material theory: basics, modelling concepts, plasticity and visco plasticity, yield functions (von Mises, Hill, ...), kinematic and isotropic hardening, damage
- thermomechanical coupling
- modelling of contact
- finite element method: explicit and implicite formulations, types of elements, numerical integration of material models
- process simulation of selected problems of sheet metal forming

T 3.270 Course: Product and Innovation Management [T-WIWI-109864]

Responsible: Prof. Dr. Martin Klarmann
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	1

Events					
SS 2019	2571154	Product and Innovation Management	2 SWS	Lecture (V)	Klarmann
Exams					
SS 2019	7900024	Product- and Innovation Management		Prüfung (PR)	Klarmann
SS 2019	7900204	Product and Innovation Management		Prüfung (PR)	Klarmann

Competence Certificate
The assessment consists of a written exam (60 minutes) (following §4(2), 1 of the examination regulation).

Prerequisites
None

Annotation
For further information please contact Marketing & Sales Research Group (marketing.iism.kit.edu).

Below you will find excerpts from events related to this course:

V Product and Innovation Management

2571154, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
This course addresses topics around the management of new as well as existing products. After the foundations of product management, especially the product choice behavior of customers, students get to know in detail different steps of the innovation process. Another section regards the management of the existing product portfolio.

Annotation
For further information please contact Marketing & Sales Research Group (marketing.iism.kit.edu).

Workload
Total effort for 3 credit points: approx. 90 hours

Presence time: 30 hours

Preparation and wrap-up of LV: 45.0 hours

Exam and exam preparation: 15.0 hours

Literature
Homburg, Christian (2016), Marketingmanagement, 6. ed., Wiesbaden.

T 3.271 Course: Product- and Production-Concepts for modern Automobiles [T-MACH-110318]

Responsible: Dr. Stefan Kienzle
Dr. Dieter Steegmüller

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2149670	Product- and Production-Concepts for modern Automobiles	2 SWS	Lecture (V)	Steegmüller, Kienzle

Competence Certificate
Oral Exam (20 min)

Prerequisites
T-MACH-105166 - Materials and Processes for Body Leightweight Construction in the Automotive Industry must not have been started.

Below you will find excerpts from events related to this course:

V Product- and Production-Concepts for modern Automobiles
Lecture (V)
2149670, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Learning Outcomes:

The students ...

- are able to name the presented general conditions of vehicle development and are able to discuss their influences on the final product using practical examples.
- are able to name the various lightweight approaches and identify possible areas of application.
- are able to identify the different production processes for manufacturing lightweight structures and explain their functions.
- are able to perform a process selection based on the methods and their characteristics.

Workload:

regular attendance: 25 hours
self-study: 95 hours

Learning Content

The lecture illuminates the practical challenges of modern automotive engineering. As former leaders of the automotive industry, the lecturers refer to current aspects of automotive product development and production.

The aim is to provide students with an overview of technological trends in the automotive industry. In this context, the course also focuses on changes in requirements due to new vehicle concepts, which may be caused by increased demands for individualisation, digitisation and sustainability. The challenges that arise in this context will be examined from both a production technology and product development perspective and will be illustrated with practical examples thanks to the many years of industrial experience of both lecturers.

The topics covered are:

- General conditions for vehicle and body development
- Integration of new drive technologies
- Functional requirements (crash safety etc.), also for electric vehicles
- Development Process at the Interface Product & Production, CAE/Simulation
- Energy storage and supply infrastructure
- Aluminium and lightweight steel construction
- FRP and hybrid parts
- Battery, fuel cell and electric motor production
- Joining technology in modern car bodies
- Modern factories and production processes, Industry 4.0.

Workload

regular attendance: 25 hours
self-study: 95 hours

T 3.272 Course: Product Development - Dimensioning of Components [T-MACH-105383]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	7	Each summer term	1

Events					
SS 2019	2150511	Product Development - Component Dimensioning	3 / 1 SWS	Lecture / Practice (VÜ)	Schulze, Dietrich
Exams					
SS 2019	76-T-MACH-105383	Product Development - Dimensioning of Components		Prüfung (PR)	Schulze

Competence Certificate
written exam (2 hours)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Product Development - Component Dimensioning
Lecture / Practice (VÜ)

2150511, SS 2019, 3 / 1 SWS, Language: German, Open in study portal

Notes
The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are

Structural dimensioning: basic stresses, superimposed stresses, notch influence, fatigue limit, fatigue strength, assessment of cracked components, operational strength, residual stresses, high temperature stress and corrosion

Material selection: Basics, material indices, material selection diagrams, Ashby procedure, multiple boundary conditions, target conflicts, shape and efficiency.

Learning target: The students...

are capable to design and dimension components according to their load.

can include mechanical material properties from the mechanical material test in the dimensioning process.

can identify superimposed total loads and critical loads on simple components and to compute them.

acquire the skill to select materials based on the application area of the components and respective loads.

Examination: written exam (2 hours)

Learning Content
The aim of the lecture is to present the topics of the dimensioning and the material science in their connection and to learn how to deal with corresponding methods and the combination thereof.

For the prospective engineer the most important educational objective is to understand the interaction of these topics while the interplay of the individual material stresses in the component are clarified.

The topics in detail are

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Learning target: The students...

are capable to design and dimension components according to their load.

can include mechanical material properties from the mechanical material test in the dimensioning process.

can identify superimposed total loads and critical loads on simple components and to compute them.

acquire the skill to select materials based on the application area of the components and respective loads.

written exam (2 hours)

learning objectives:

The students...

are capable to design and dimension components according to their load.

can include mechanical material properties from the mechanical material test in the dimensioning process.

can identify superimposed total loads and critical loads on simple components and to compute them.

acquire the skill to select materials based on the application area of the components and respective loads.

requirements:

workload:

Literature
Lecture notes

T 3.273 Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

Responsible: Dr.-Ing. Sama Mbang
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2123364	Product, Process and Resource Integration in the Automotive Industry	2 SWS	Lecture (V)	Mbang
Exams					
SS 2019	76-T-MACH-102155	Product, Process and Resource Integration in the Automotive Industry		Prüfung (PR)	Mbang

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Annotation
Limited number of participants.

Below you will find excerpts from events related to this course:

V Product, Process and Resource Integration in the Automotive Industry — Lecture (V)
2123364, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The lecture

- Overview of product development in the automotive sector (process- and work cycle, IT-Systems)
- Integrated product models in the automotive industry (product, process and resource)
- New CAx modeling methods (intelligent feature technology, templates & functional modeling)
- Automation and knowledge-based mechanism for product design and production planning
- Product development in accordance with defined process and requirement (3D-master principle, tolerance models)
- Concurrent Engineering, shared working
- Enhanced concepts: the digital and virtual factory (application of virtual technologies and methods in the product development)
- Systems: Siemens NX .

Additionally, A practical industrial project study is offered, which is based on an integrated application scenario (from design of production resources, over testing and validation method planning to the manufacturing and implementation of the production resources).

Since the student will be divided in small teams, this study will also teach the students about team word and distributed development.

Annotation
Max. 20 students, registration necessary (ILIAS)

Workload
regular attendance: 32 hours
self-study: 72 hours

Literature
Lecture slides

T 3.274 Course: Production and Logistics Controlling [T-WIWI-103091]

Responsible: Alexander Rausch
Organisation: KIT Department of Economics and Management
Part of: M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Exams				
SS 2019	79-T-WIWI-103091	Production and Logistics Controlling	Prüfung (PR)	Furmans, Mittwollen

Competence Certificate
The assessment consists of a written exam (60 minutes) following §4(2), 1 of the examination regulation.
The exam takes place in every semester. Re-examinations are offered at every ordinary examination date.

Prerequisites
None

T 3.275 Course: Production Planning and Control [T-MACH-105470]

Responsible: Dr.-Ing. Andreas Rinn
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2110032	Production Planning and Control	2 SWS		Rinn

Competence Certificate
written exam 60 minutes (if the number of participants is low, the examination is oral, 20 minutes)

Prerequisites
Timely pre-registration in ILIAS, since participation is limited.

Below you will find excerpts from events related to this course:

V Production Planning and Control
2110032, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

1. Goals and recommanditions for production planning and control
2. Strategies for work control
3. Case study: Manufacturing of bicycles
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control
5. Simulation of the order processing
6. Decision making about order control and procurement of purchased parts
7. Evaluation of the simulation protocols
8. Realisation of production planning and control

Requirements:

- Compact course
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge in Production Management/Industrial Engineering is required
- Knowledge of Work Science and Economics is helpful
- Knowledge of Informatics is not required, but helpful

Learning targets:

- Lerninhalte zum Thema "Produktionsmanagement" vertiefen
- Kenntnisse über die Produktionsplanung und -steuerung erweitern
- Grundlegende Techniken der Modellierung und Simulation von Produktionssystemen verstehen

Learning Content

1. Goals and recommanditions for production planning and control
2. Strategies for work control
3. Case study: Manufacturing of bicycles
4. FASI-Plus: Simulation of a bicycle factory for the production planning and control
5. Simulation of the order processing
6. Decision making about order control and procurement of purchased parts
7. Evaluation of the simulation protocols
8. Realisation of production planning and control

Workload

Compact course.

The amount of work accounts for 120 h (=4 ECTS).

Literature

Handout and literature are available on ILIAS for download.

T 3.276 Course: Production Techniques Laboratory [T-MACH-105346]

Responsible: Prof. Dr.-Ing. Barbara Deml
Prof. Dr.-Ing. Jürgen Fleischer
Prof. Dr.-Ing. Kai Furmans
Prof. Dr.-Ing. Jivka Ovtcharova

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Completed coursework	4	Each summer term	3

Events					
SS 2019	2110678	Production Techniques Laboratory	4 SWS	Practical course (P)	Deml, Fleischer, Furmans, Ovtcharova
Exams					
SS 2019	76-T-MACH-105346	Production Techniques Laboratory		Prüfung (PR)	Deml, Furmans, Ovtcharova, Schulze

Competence Certificate
Advanced Internship: Participate in practicle exercise courses and complete the colloquia successfully.

Elective Subject: Participate in practicle exercise courses and complete the colloquia successfully and presentation of a specific topic.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Production Techniques Laboratory
2110678, SS 2019, 4 SWS, Language: German, Open in study portal

Practical course (P)

Description
Media:

several

Notes
The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Production Management (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Recommendations:

Participation in the following lectures:

- Informationssystems in logistics and supply chain management
- Material flow in logistic systems
- Manufacturing technology
- Human Factors Engineering

Learning Objects:

The students acquire in the lab profound knowledge about the scientific theories, principles and methods of Production Engineering. Afterwards they are able to evaluate and design complex production systems according to problems of manufacturing and process technologies, materials handling, handling techniques, information engineering as well as production organisation and management.

After completion this lab, the students are able

- to analyse and solve planning and layout problems of the discussed fields,
- to evaluate and configure the quality and efficiency of production, processes and products,
- to plan, control and evaluate the production of a production enterprise,
- to configure and evaluate the IT architecture of a production enterprise,
- to design and evaluate appropriate techniques for conveying, handling and picking within a production system,
- to design and evaluate the part production and the assembly by considering the work processes and the work places.

Learning Content
The production technique laboratory (PTL) is a collaboration of the institutes wbk, IFL, IMI and ifab.

1. Computer Aided Product Development (IMI)
2. Computer communication in factory (IMI)
3. Production of parts with CNC turning machines (wbk)
4. Controlling of production systems using PLCs (wbk)
5. Automated assembly systems (wbk)
6. Optical identification in production and logistics (IFL)
7. RFID identification systems (IFL)
8. Storage and order-picking systems (IFL)
9. Production Management (ifab)
10. Time study (ifab)
11. Accomplishment of workplace design (ifab)

Annotation
none

Workload
The amount of work is 120 h (=4 ECTS).

Literature
Handouts and literature references are available online on ILIAS.

T 3.277 Course: Productivity Management in Production Systems [T-MACH-105523]

Responsible: Prof. Dr. Sascha Stowasser
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2110046	Productivity Management in Production Systems	4 SWS		Stowasser
Exams					
SS 2019	76-T-MACH-105523	Productivity Management in Production Systems		Prüfung (PR)	Deml

Competence Certificate
oral exam (approx. 30 min)

The exam is offered in German only!

Prerequisites
none

Below you will find excerpts from events related to this course:

V Productivity Management in Production Systems
2110046, SS 2019, 4 SWS, Language: German, Open in study portal

Description
Media:

Powerpoint, movies, exercises

Notes

1. Definition and terminology of process design and industrial engineering
2. Tasks of industrial engineering
3. Actual approaches of organisation of production (Holistic production systems, Guided group work et al.)
4. Methods and principles of industrial engineering and production systems
5. Case studies and exercises for process design
6. Industry 4.0

Requirements:

- Compact course (one week full-time)
- Limited number of participants; seats are assigned according the date of registration
- Registration via ILIAS is required
- Compulsory attendance during the whole lecture

Recommendations:

- Knowledge of work science is helpful

Learning objective:

- Ability to design work operations and processes effecitvely and efficiently
- Instruction in methods of time study (MTM, Data acquisition etc.)
- Instruction in methods and principles of process design
- The Students are able to apply methods for the design of workplaces, work operations and processes.
- The Students are able to apply actual approaches of process and production organisation.

Learning Content

1. Definition and terminology of process design and industrial engineering
2. Tasks of industrial engineering
3. Actual approaches of organisation of production (Holistic production systems, Guided group work et al.)
4. Methods and principles of industrial engineering and production systems
5. Case studies and exercises for process design
6. Industry 4.0

Workload
Compact course (one week full-time).

The amount of work accounts for 120 h (=4 ECTS).

Literature
Handout and literature is available on ILIAS for download.

T 3.278 Course: Project Management in Global Product Engineering Structures [T-MACH-105347]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Peter Gutzmer
Prof. Dr.-Ing. Sven Matthiesen

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2145182	Project management in Global Product Engineering Structures	2 SWS	Lecture (V)	Gutzmer

Competence Certificate
oral exam (20 min)

Aids: None

Prerequisites
none

Below you will find excerpts from events related to this course:

V Project management in Global Product Engineering Structures
Lecture (V)

2145182, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Product development process

Coordination of product development and handling of complexity

project management

matrix organization

planning / specification / target system

interaction of development and production

Workload
regular attendance: 21 h

self-study: 99 h

Literature
lecture notes

T 3.279 Course: Project Management in Rail Industry [T-MACH-104599]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2115995	Project Management in Rail Industry	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-104599	Project Management in Rail Industry		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-104599	Project Management in Rail Industry		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Project Management in Rail Industry
2115995, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes
Rail vehicles are capital-intensive goods which are manufactured in small series (like aircraft). The work to done at industry and customers is organized in "projects". This is completely different to the way of working in large-scale production (like car industry). Everybody working in this type of business is part of a project and should be aware of the typical processes.

The lecturer provides a comprehensive overview about modern project management for small series of capital-intensive goods. The content is valid not for rail vehicle business but also for other areas with similar business processes.
The following topics will be discussed:

1. Introduction: definition of project and project management
2. Project management system: project phases, main processes and supporting processes, governance
3. Organization: organizational structure within a company, project organization, roles in a project organization
4. Main processes: project start, project plan, work brake down structure, detailed project schedule, risk and opportunity management, change management, project closure
5. Governance

Learning Content

Rail vehicles are capital-intensive goods which are manufactured in small series (like aircraft). The work to done at industry and customers is organized in "projects". This is completely different to the way of working in large-scale production (like car industry). Everybody working in this type of business is part of a project and should be aware of the typical processes.

The lecturer provides a comprehensive overview about modern project management for small series of capital-intensive goods. The content is valid not for rail vehicle business but also for other areas with similar business processes.
The following topics will be discussed:

1. Introduction: definition of project and project management
2. Project management system: project phases, main processes and supporting processes, governance
3. Organization: organizational structure within a company, project organization, roles in a project organization
4. Main processes: project start, project plan, work brake down structure, detailed project schedule, risk and opportunity management, change management, project closure
5. Governance

Annotation

None.

Workload

Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature

A bibliography is available for download (Ilias-platform).

T 3.280 Course: Project Mikromanufacturing: Development and Manufacturing of Microsystems [T-MACH-105457]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Examination of another type	5	Each winter term	2

Events					
WS 19/20	2149680	Project Micro-Manufacturing: Design and Manufacturing of a Microsystem	3 SWS		Schulze, Dehen
Exams					
SS 2019	76-T-MACH-105457	Project Mikromanufacturing: Development and Manufacturing of Microsystems		Prüfung (PR)	Schulze

Competence Certificate
Alternative test achievement (graded):

- presentation (about 15 min) with weighting 40%
- scientific colloquium (about 15 min) with weighting 40%
- Project work (graded) with weighting 20%

Prerequisites
None

Below you will find excerpts from events related to this course:

V Project Micro-Manufacturing: Design and Manufacturing of a Microsystem
2149680, WS 19/20, 3 SWS, Language: German, Open in study portal

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

The course "Project micro manufacturing: design and manufacturing of a micro system" combines the basics of micro manufacturing with project work. The project work will be done in cooperation with an industry partner. The students learn the basics of micro milling, micro electric discharge machining, micro laser ablation, micro powder injection molding and micro quality assurance. Furthermore they get to know the CAD-CAM process chain. That is the manufacturing of a production out of a CAD model. The students develop ideas and concepts matching the given task and present the results to the industry partner. Then they create parts that are designed for manufacturability out of their concepts. Those parts are manufactured at the wbk and finally assembled to a prototype.

Learning Outcomes:

The students ...

- are able to describe the micro manufacturing processes as well as their characteristics and applications.
- can choose suitable manufacturing processes for a given product.
- are able to describe the process along the CAD-CAM process chain from scratch to manufacturing.
- can explain how the development process for a micro product looks like.
- are able to describe how design for manufacturability works for micro products and where the differences to macroscopic scale are.

Workload:

regular attendance: 31,5 hours
self-study: 148,5 hours

Learning Content

The course "Project micro manufacturing: design and manufacturing of a micro system" combines the basics of micro manufacturing with project work. The project work will be done in cooperation with an industry partner. The students learn the basics of micro milling, micro electric discharge machining, micro laser ablation, micro powder injection molding and micro quality assurance. Furthermore they get to know the CAD-CAM process chain. That is the manufacturing of a production out of a CAD model. The students develop ideas and concepts matching the given task and present the results to the industry partner. Then they create parts that are designed for manufacturability out of their concepts. Those parts are manufactured at the wbk and finally assembled to a prototype.

Workload

regluar attendance: 31,5 hours
self-study: 148,5 hours

T 3.281 Course: Project Workshop: Automotive Engineering [T-MACH-102156]

Responsible: Dr.-Ing. Michael Frey
Prof. Dr. Frank Gauterin
Dr.-Ing. Martin Gießler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each term	1

Events					
SS 2019	2115817	Project Workshop: Automotive Engineering	3 SWS	Lecture (V)	Gauterin, Gießler, Frey
WS 19/20	2115817	Project Workshop: Automotive Engineering	3 SWS	Lecture (V)	Gauterin, Gießler, Frey
Exams					
SS 2019	76-T-MACH-102156	Project Workshop: Automotive Engineering		Prüfung (PR)	Gauterin

Competence Certificate
Oral examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Project Workshop: Automotive Engineering
2115817, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Annotation
Selection procedure, applications are to submit in the end of the preceding semester.

Workload
regular attendance: 49 hours
self-study:131 hours

Literature
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

The scripts will be supplied in the start-up meeting.

V **Project Workshop: Automotive Engineering** **Lecture (V)**
2115817, WS 19/20, 3 SWS, Language: German, Open in study portal

Notes
Limited number of participants with selection procedure, in German language. Please send the application at the end of the previous semester
Date and room: see homepage of institute.

Learning Content
During the Project Workshop Automotive Engineering a team of six persons will work on a task given by an German industrial partner using the instruments of project management. The task is relevant for the actual business and the results are intended to be industrialized after the completion of the project workshop.

The team will generate approaches in its own responsibility and will develop solutions for practical application. Coaching will be supplied by both, company and institute.

At the beginning in a start-up meeting goals and structure of the project will be specified. During the project workshop there will be weekly team meetings. Also a milestone meeting will be held together with persons from the industrial company. In a final presentation the project results will be presented to the company management and to institute representatives.

Annotation
Selection procedure, applications are to submit in the end of the preceding semester.

Workload
regular attendance: 49 hours
self-study: 131 hours

Literature
Steinle, Claus; Bruch, Heike; Lawa, Dieter (Hrsg.), Projektmanagement, Instrument moderner Innovation, FAZ Verlag, Frankfurt a. M., 2001, ISBN 978-3929368277

The scripts will be supplied in the start-up meeting.

T 3.282 Course: Quality Management [T-MACH-102107]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2149667	Quality Management	2 SWS	Lecture (V)	Lanza
Exams					
SS 2019	76-T-MACH-102107	Quality Management		Prüfung (PR)	Lanza

Competence Certificate
Written Exam (60 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Quality Management — Lecture (V)
2149667, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/)

Notes

Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.

Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Learning Outcomes:

The students ...

- are capable to comment on the content covered by the lecture.
- are capable of substantially quality philosophies.
- are able to apply the QM tools and methods they have learned about in the lecture to new problems from the context of the lecture.
- are able to analyze and evaluate the suitability of the methods, procedures and techniques they have learned about in the lecture for a specific problem.

Workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Based on the quality philosophies Total Quality Management (TQM) and Six Sigma, the lecture deals with the requirements of modern quality management. Within this context, the process concept of a modern enterprise and the process-specific fields of application of quality assurance methods are presented. The lecture covers the current state of the art in preventive and non-preventive quality management methods in addition to manufacturing metrology, statistical methods and service related quality management. The content is completed with the presentation of certification possibilities and legal quality aspects.
Main topics of the lecture:

- The term "Quality"
- Total Quality Management (TQM) and Six Sigma
- Universal methods and tools
- QM during early product stages – product denition
- QM during product development and in procurement
- QM in production – manufacturing metrology
- QM in production – statistical methods
- QM in service
- Quality management systems
- Legal aspects of QM

Annotation

None

Workload

regular attendance: 21 hours
self-study: 99 hours

T 3.283 Course: Rail System Technology [T-MACH-106424]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2115919	Rail System Technology	2 SWS	Lecture (V)	Gratzfeld
WS 19/20	2115919	Rail System Technology	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-106424	Rail System Technology		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-106424	Rail System Technology		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Rail System Technology
2115919, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Learning Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

V Rail System Technology

2115919, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signaling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Learning Content

1. Railway System: railway as system, subsystems and interdependencies, definitions, laws, rules, railway and environment, economic impact
2. Operation: Transportation, public transport, regional transport, long-distance transport, freight service, scheduling
3. Infrastructure: rail facilities, track alignment, railway stations, clearance diagram
4. Wheel-rail-contact: carrying of vehicle mass, adhesion, wheel guidance, current return
5. Vehicle dynamics: tractive and brake effort, driving resistance, inertial force, load cycles
6. Signalling and Control: operating procedure, succession of trains, European Train Control System, blocking period, automatic train control
7. Traction power supply: power supply of rail vehicles, power networks, filling stations
8. History (optional)

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

T 3.284 Course: Rail Vehicle Technology [T-MACH-105353]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2115996	Rail Vehicle Technology	2 SWS	Lecture (V)	Gratzfeld
WS 19/20	2115996	Rail Vehicle Technology	2 SWS	Lecture (V)	Gratzfeld
Exams					
SS 2019	76-T-MACH-105353	Rail Vehicle Technology		Prüfung (PR)	Gratzfeld
SS 2019	76-T-MACH-105355	Rail Vehicle Technology		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-105353	Rail Vehicle Technology		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Rail Vehicle Technology
2115996, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

All slides are available for download (Ilias-platform).

Notes

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Learning Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

V | **Rail Vehicle Technology** | **Lecture (V)**
2115996, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Learning Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, interfaces
3. Bogies: forces, running gears, axle configuration
4. Drives: vehicle with/without contact wire, dual-mode vehicle
5. Brakes: tasks, basics, principles, blending, brake control
6. Train control management system: definitions, networks, bus systems, components, examples
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck coaches, locomotives, freight wagons

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
A bibliography is available for download (Ilias-platform).

T 3.285 Course: Railways in the Transportation Market [T-MACH-105540]

Responsible: Prof. Dr.-Ing. Peter Gratzfeld
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114914	Railways in the Transportation Market	2 SWS	Block (B)	Gratzfeld
Exams					
SS 2019	76-T-MACH-105540	Railways in the Transportation Market		Prüfung (PR)	Gratzfeld
WS 19/20	76-T-MACH-105540	Railways in the Transportation Market		Prüfung (PR)	Gratzfeld

Competence Certificate
Oral examination

Duration: ca. 20 minutes

No tools or reference materials may be used during the exam.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Railways in the Transportation Market
2114914, SS 2019, 2 SWS, Language: German, Open in study portal

Block (B)

Description
Media:

All material is available for download (Ilias-platform).

Notes
The lecture gives an overview about perspective, challenges and chances of rail systems in the national and European market. Following items will be discussed:

- Introduction and basics
- Rail reform
- Overview of Deutsche Bahn
- Development of infrastructure
- Regulation of railways
- Intra- and intermodal competition
- Field of actions in transport policy
- Railways and enviroment
- Trends in the transportation market
- Future of Deutsche Bahn, DB 2020
- Integration of traffic carriers
- International passenger and freight transportation

Learning Content
The lecture gives an overview about perspective, challenges and chances of rail systems in the national and European market. Following items will be discussed:

- Introduction and basics
- Rail reform
- Overview of Deutsche Bahn
- Development of infrastructure
- Regulation of railways
- Intra- and intermodal competition
- Field of actions in transport policy
- Railways and enviroment
- Trends in the transportation market
- Future of Deutsche Bahn, DB 2020
- Integration of traffic carriers
- International passenger and freight transportation

Workload
Regular attendance: 21 hours

Self-study: 21 hours

Exam and preparation: 78 hours

Literature
none

T 3.286 Course: Reactor Safety I: Fundamentals [T-MACH-105405]

Responsible: Dr. Victor Hugo Sanchez-Espinoza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2189465	Reactor Safety I: Fundamentals	2 SWS	Lecture (V)	Sanchez-Espinoza
Exams					
SS 2019	76-T-MACH-105405	Reactor Safety I: Fundamentals		Prüfung (PR)	Sanchez-Espinoza, Stieglitz
WS 19/20	76-T-MACH-105405	Reactor Safety I: Fundamentals		Prüfung (PR)	Sanchez-Espinoza

Competence Certificate
oral exam about 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Reactor Safety I: Fundamentals

2189465, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Description
In the lecture, the fundamental principles and concepts of reactor safety are discussed. They facilitate the assessment of the safety status of nuclear power plants and the interpretation of incidents or accidents as such as Chernobyl or Fukushima. Starting with the explanations of the technical safety features of reactor systems, the safety concepts of different reactor types are discussed. The initiation and progression of incidents/accidents as well as the methods for the safety evaluation are also treated in the lecture. Discussing the Fukushima accident, the radiological risk from nuclear power plants together with the counter measures to stop severe accident and to limit the consequences will be explained. Finally, new development to increase the safety or reactors of Generation III and IV will be presented.

Notes

This lecture will be given in English, if required in German

The lecture discuss the fundamental principles and concepts of reactor safety including the methologies for safety assessment and major accidents.

In the lecture, the fundamental principles and concepts of reactor safety are discussed. They facilitate the assessment of the safety status of nuclear power plants and the interpretation of incidents or accidents as such as Chernobyl or Fukushima. Starting with the explanations of the technical safety features of reactor systems, the safety concepts of different reactor types are discussed. The initiation and progression of incidents/accidents as well as the methods for the safety evaluation are also treated in the lecture. Discussing the Fukushima accident, the radiological risk from nuclear power plants together with the counter measures to stop severe accident and to limit the consequences will be explained. Finally, new development to increase the safety or reactors of Generation III and IV will be presented.

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Lernziele

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Knowledge in energy technology, nuclear power plants, reactor physics, thermal hydraulic of nuclear reactors is welcomed

regular attendance: 30 h
self-study: 60 h

Zielgruppe: Students of Mechanical Engineering,

oral examination, duration approximately 30 minutes

Learning Content

Lecture Content:

- National and international nuclear regulations
- Fundamental principles of reactor safety
- Implementation of safety principles in nuclear power plants of generation 2
- Safety analysis and methods for safety assessment
- Nuclear events and accidents and its evaluation methods
- Discussion severe accidents e.g. the Fukushima accident
- Safety features of reactor systems of generation 3 and 4

Workload

regular attendance: 30 h
self-study: 60 h

Literature

- G. Kessler at al; Risks of Nuclear Energy Technology- Safety Concepts of Light Water Reactors. Springer Verlag 2014.
- B. R. Sehgal; Nuclear Safety in LWR: Severe Accident Phenomenology. Academic Press Elsevier. 2012.
- John C. Lee and Norman J. McCormick.July; Risk and Safety Analysis of Nuclear Systems. 2011
- G. Petrangeli; Nuclear Safety. Elsevier Butterworth-Heinemann. 2006
- J. N. Lillington; Light Water Reactor Safety: The Development of Advanced Models and Codes for Light Water Reactor Safety Analysis. Elsevier 1995.

T 3.287 Course: Reduction Methods for the Modeling and the Simulation of Vombustion Processes [T-MACH-105421]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2166543	Reduction methods for the modeling and the simulation of combustion processes	2 SWS	Lecture (V)	Bykov

Competence Certificate
oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Reduction methods for the modeling and the simulation of combustion processes — Lecture (V)
2166543, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
The course will introduce the principles of model reduction of chemical kinetic models of combustion processes. The basic mathematical concepts and methods of analysis of chemical reaction mechanisms will be outlined in the context of model reduction. The detailed implementation scheme of model reduction will be introduced. The course will cover simplified and idealized models of combustion (e.g. auto-ignition, explosion, deflagration etc.), which will be analyzed and reduced. The main analytical methods and numerical tools will be presented, evaluated and illustrated by using these simple examples.

Workload
regular attendance: 21 hours

self-study: 100,0 hours

Literature
N. Peters, B. Rogg: Reduced kinetic mechanisms for aplication in combustion systems, Lecture notes in physics, 15, Springer Verlag, 1993.

T 3.288 Course: Reliability Engineering 1 [T-MACH-107447]

Responsible: Dr.-Ing. Alexei Konnov
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	3	Each winter term	1

Events					
WS 19/20	2169550	Reliability Engineering 1	2 SWS	Lecture (V)	Konnov

Competence Certificate
written exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Reliability Engineering 1

2169550, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Learning Content
Technical background: instrumentation and control systems in power plants

Introduction to reliability theory
Introduction to probability theory
Introduction to formal logic
Introduction to statistic

Workload
regular attandance: 25 h

self-study: 65 h

Literature
Lesson script (link will be available)

Recommended books:

o Birolini, Alessandro: *Reliability Engineering Theory and Practice*

o Pham, Hoang: *Handbook of reliability engineering*

T 3.289 Course: Renewable Energy-Resources, Technologies and Economics [T-WIWI-100806]

Responsible: PD Dr. Patrick Jochem
Prof. Dr. Russell McKenna

Organisation: KIT Department of Economics and Management

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-104884 - Courses of the Department of Economics and Management

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	3

Events					
WS 19/20	2581012	Renewable Energy – Resources, Technologies and Economics	2 SWS	Lecture (V)	McKenna, Jochem
Exams					
SS 2019	7981012	Renewable Energy-Resources, Technologies and Economics		Prüfung (PR)	Fichtner

Competence Certificate
The assessment consists of a written exam (60 min., in English, answers in English or German) according to § 4 paragraph 2 Nr. 1 of the examination regulation SPO2015.

Prerequisites
None.

Below you will find excerpts from events related to this course:

V Renewable Energy – Resources, Technologies and Economics
Lecture (V)

2581012, WS 19/20, 2 SWS, Language: English, Open in study portal

Learning Content
1. General introduction: Motivation, Global situation
2. Basics of renewable energies: Energy balance of the earth, potential definition
3. Hydro
4. Wind
5. Solar
6. Biomass
7. Geothermal
8. Other renewable energies
9. Promotion of renewable energies
10. Interactions in systemic context
11. Excursion to the "Energieberg" in Mühlburg

Workload
The total workload for this course is approximately 105.0 hours. For further information see German version.

Literature
Elective literature:

- Kaltschmitt, M., 2006, Erneuerbare Energien : Systemtechnik, Wirtschaftlichkeit, Umweltaspekte, aktualisierte, korrigierte und ergänzte Auflage Berlin, Heidelberg : Springer-Verlag Berlin Heidelberg.
- Kaltschmitt, M., Streicher, W., Wiese, A. (eds.), 2007, Renewable Energy: Technology, Economics and Environment, Springer, Heidelberg.
- Quaschning, V., 2010, Erneuerbare Energien und Klimaschutz : Hintergründe - Techniken - Anlagenplanung – Wirtschaftlichkeit München : Hanser, Ill.2., aktualis. Aufl.
- Harvey, D., 2010, Energy and the New Reality 2: Carbon-Free Energy Supply, Eathscan, London/Washington.
- Boyle, G. (ed.), 2004, Renewable Energy: Power for a Sustainable Future, 2nd Edition, Open University Press, Oxford.

T 3.290 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	6	Each winter term	1

Events					
WS 19/20	2424152	Robotics I - Introduction to Robotics	3/1 SWS	Lecture (V)	Asfour
Exams					
SS 2019	7500218	Robotik I - Einführung in die Robotik		Prüfung (PR)	Asfour
WS 19/20	7500106	Robotics I - Introduction to Robotics		Prüfung (PR)	Asfour

T 3.291 Course: Robotics II: Humanoid Robotics [T-INFO-105723]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	3

Events					
SS 2019	2400074	Robotics II: Humanoid Robotics	2 SWS	Lecture (V)	Asfour, Wächter
Exams					
SS 2019	7500086	Robotics II: Humanoid Robotics		Prüfung (PR)	Asfour
WS 19/20	7500211	Robotics II: Humanoid Robotics		Prüfung (PR)	Asfour

Below you will find excerpts from events related to this course:

V Robotics II: Humanoid Robotics

2400074, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Learning Content

The lecture presents current work in the field of humanoid robotics that deals with the implementation of complex sensorimotor and cognitive abilities. In the individual topics different methods and algorithms, their advantages and disadvantages, as well as the current state of research are discussed.

The topics addressed are: biomechanical models of the human body, biologically inspired and data-driven methods of grasping, active perception, imitation learning and programming by demonstration as well as semantic representations of sensorimotor experience

Workload

90 h

T 3.292 Course: Robotics III - Sensors and Perception in Robotics [T-INFO-109931]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-104883 - Courses of the Department of Informatics

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	2

Events					
SS 2019	2400067	Robotics III - Sensors and Perception in Robotics	2 SWS	Lecture (V)	Asfour, Grotz
Exams					
SS 2019	7500242	Robotics III - Sensors and Perception in Robotics		Prüfung (PR)	Asfour

Below you will find excerpts from events related to this course:

V Robotics III - Sensors and Perception in Robotics

2400067, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Learning Content

The lecture supplements the lecture Robotics I with a broad overview of sensors used in robotics. The lecture focuses on visual perception, object recognition, simultaneous localization and mapping (SLAM) and semantic scene interpretation. The lecture is divided into two parts:

In the first part a comprehensive overview of current sensor technologies is given. A basic distinction is made between sensors for the perception of the environment (exteroceptive) and sensors for the perception of the internal state (proprioceptive).

The second part of the lecture concentrates on the use of exteroceptive sensors in robotics. The topics covered include tactile exploration and visual data processing, including advanced topics such as feature extraction, object localization, simultaneous localization and mapping (SLAM) and semantic scene interpretation.

Workload

90h

T 3.293 Course: Safety Engineering [T-MACH-105171]

Responsible: Hans-Peter Kany
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2117061	Safety Engineering	2 SWS	Lecture (V)	Kany
Exams					
SS 2019	7600017	Safety Engineering		Prüfung (PR)	Kany

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Safety Engineering
Lecture (V)
2117061, WS 19/20, 2 SWS, Language: German, Open in study portal

Description
Media:
presentations

Notes

Media

Presentations

Learning content

The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

Learning goals

The students are able to:

- Name and describe relevant safety concepts of safety engineering,
- Discuss basics of health at work and labour protection in Germany,
- Evaluate the basics for the safe methods of design of machinery with the national and European safety regulations and
- Realize these objectives by using examples in the field of storage and material handling systems.

Recommendations

None

Workload

Regular attendance: 21 hours
Self-study: 99 hours

Note

Dates: See IFL-Homepage

Learning Content

The course provides basic knowledge of safety engineering. In particular the basics of health at the working place, job safety in Germany, national and European safety rules and the basics of safe machine design are covered. The implementation of these aspects will be illustrated by examples of material handling and storage technology. This course focuses on: basics of safety at work, safety regulations, basic safety principles of machine design, protection devices, system security with risk analysis, electronics in safety engineering, safety engineering for storage and material handling technique, electrical dangers and ergonomics. So, mainly, the technical measures of risk reduction in specific technical circumstances are covered.

Annotation

none

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Defren/Wickert: Sicherheit für den Maschinen- und Anlagenbau, Druckerei und
Verlag: H. von Ameln, Ratingen, ISBN: 3-926069-06-6

T 3.294 Course: Scaling in Fluid Dynamics [T-MACH-105400]

Responsible: Prof. Dr. Leo Bühler
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2154044	Scaling in fluid dynamics	2 SWS	Lecture (V)	Bühler
Exams					
SS 2019	76-T-MACH-105400	Scaling in Fluid Dynamics		Prüfung (PR)	Bühler

Competence Certificate
Oral exam

Duration: 20-30 minutes

No auxiliary means

Prerequisites
none

Recommendation
Fluid Mechanics (T-MACH-105207)

Below you will find excerpts from events related to this course:

V Scaling in fluid dynamics

2154044, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Introduction
- Similarity rules (examples)
- Dimensional analysis (Pi-theorem)
- Scaling in differential equations
- Scaling in boundary layers
- Self-similar solutions
- Scaling in turbulent shear layers
- Rotating flows
- Magnetohydrodynamic flows

Educational objective: The student can extract non-dimensional number from the characteristic properties of flows. From the insights on scaling laws, the students are qualified to identify the influencing quantities from generic experiments and transfer these to real applications. The students can simplify the governing equations of fluid mechanic appropriately and can interpret the achieved results as a basis for efficient solution strategies.

Learning Content

- Introduction
- Similarity rules (examples)
- Dimensional analysis (Pi-theorem)
- Scaling in differential equations
- Scaling in boundary layers
- Self-similar solutions
- Scaling in turbulent shear layers
- Rotating flows
- Magnetohydrodynamic flows

Annotation
Recommendation: Fluid Mechanics

Workload
Regular attendance: 32 hours

self-study: 88 hours

Literature
G. I. Barenblatt, 1979, Similarity, Self-Similarity, and Intermediate Asymptotics, Plenum Publishing Corporation (Consultants Bureau)

J. Zierep, 1982, Ähnlichkeitsgesetze und Modellregeln der Strömungsmechanik, Braun

J. H. Spurk, 1992, Dimensionsanalyse in der Strömungslehre, Springer

T 3.295 Course: Selected Chapters of the Combustion Fundamentals [T-MACH-105428]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each term	1

Events					
SS 2019	2167541	Selected chapters of the combustion fundamentals	2 SWS	Lecture (V)	Maas
WS 19/20	2167541	Selected chapters of the combustion fundamentals	2 SWS	Lecture (V)	Maas

Competence Certificate
Oral exam (20 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Selected chapters of the combustion fundamentals

2167541, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Blackboard and Powerpoint presentation

Learning Content
Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

Workload
Regular attendance: 21,5 hours
Self-study: 98,5 hours

Literature
Lecture notes

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, authors: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V Selected chapters of the combustion fundamentals

2167541, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Blackboard and Powerpoint presentation

Learning Content
Depending on the lecture: Fundamentals of chemical kinetics, of statistical modeling of turbulent flames or of droplet and spray combustion.

Workload
Regular attendance: 22.5 h
Self-study: 97.5 h

Literature
Lecture notes

Combustion - Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, authors: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 3.296 Course: Selected Problems of Applied Reactor Physics and Exercises [T-MACH-105462]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190411	Selected Problems of Applied Reactor Physics and Exercises	2 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-105462	Selected Problems of Applied Reactor Physics and Exercises		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam, 1/2 hour

Prerequisites
none

Below you will find excerpts from events related to this course:

V Selected Problems of Applied Reactor Physics and Exercises
2190411, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes

- Nuclear energy and forces
- Radioactive decay
- Nuclear processes
- Fission and the importance of delayed neutrons
- Basics of nuclear cross sections
- Principles of chain reaction
- Static theory of mono energetic reactors
- Introduction to reactor kinetic
- student laboratory

The students

- have solid understanding of the basic reactor physics
- are able to estimate processes of growth and decay of radionuclides; out of it, they can perform dose calculation and introduce their biological hazards
- can calculate the relationship of basic parameters which are needed for a stable reactor operation
- understand important dynamical processes of nuclear reactors.

Regular attendance: 26 h

self study 94 h

oral exam about 30 min.

Learning Content

- Nuclear energy and forces
- Radioactive decay
- Nuclear processes
- Fission and the importance of delayed neutrons
- Basics of nuclear cross sections
- Principles of chain reaction
- Static theory of mono energetic reactors
- Introduction to reactor kinetic
- student laboratory

Workload
Regular attendance: 26 h

self study 94 h

Literature
K. Wirtz Basics of Reactor technic Par I, II, Technic School Karlsruhe 1966 (in German)

D. Emendorfer. K.H. Höcker Theory of nuclear reactions, BI- Hochschultaschenbücher 1969 (in German)

J. Duderstadt and L. Hamilton, Nuclear reactor Analysis, J. Wiley $ Sons, Inc. 1975.

T 3.297 Course: Seminar in Materials Science [T-MACH-100290]

Responsible: Dr. Patric Gruber
Dr. rer. nat. Stefan Wagner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework	2	Each summer term	2

Events					
SS 2019	2178450	Seminar in Materials Science	2 SWS	Seminar (S)	Gruber, Wagner
Exams					
SS 2019	76-T-MACH-100290	Seminar in Materials Science		Prüfung (PR)	Gruber, Wagner

Competence Certificate
Attendance on all seminars

Preparation of an oral talk (meeting with mentor)

Presentation of oral talk

Prerequisites
Materials Physics, Metals, basics in Ceramics

Below you will find excerpts from events related to this course:

V Seminar in Materials Science
2178450, SS 2019, 2 SWS, Language: German, Open in study portal

Seminar (S)

Learning Content
Topics in materials science within the framework of the lectures Materials Physics, Metals and Introduction to Ceramics.

Literature
Topic specific

T 3.298 Course: Seminar Novel Concepts for Solar Energy Harvesting [T-ETIT-108344]

Responsible: Prof. Dr. Bryce Sydney Richards
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Examination of another type	3	Each summer term	2

Events					
SS 2019	2313761	Seminar Novel Concepts for Solar Energy Harvesting	2 SWS	Seminar (S)	Paetzold, Richards
Exams					
SS 2019	7313761	Seminar Novel Concepts for Solar Energy Harvesting		Prüfung (PR)	Richards

Prerequisites
none

3.299 Course: Signals and Systems [T-ETIT-109313]

Responsible: Prof. Dr.-Ing. Fernando Puente León
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Expansion	Version
Written examination	6	Each winter term	1 terms	1

Events					
WS 19/20	2302109	Signals and Systems	2 SWS	Lecture (V)	Puente León

Prerequisites
none

T 3.300 Course: Simulation of Coupled Systems [T-MACH-105172]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2114095	Simulation of Coupled Systems	2 SWS	Lecture (V)	Geimer, Xiang
Exams					
SS 2019	76T-MACH-102172	Simulation of Coupled Systems		Prüfung (PR)	Geimer
SS 2019	76T-MACH-105172	Simulation of Coupled Systems		Prüfung (PR)	Geimer
WS 19/20	76T-MACH-105172	Simulation of Coupled Systems		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an oral exam (20 min) taking place in the recess period. The exam takes place in every semester. Re-examinations are offered at very ordinary examination date.

A registration in mandatory, the details will be announced on the webpages of the *Institute of Vehicle System Technology / Institute of Mobile Machines*. In case of too many applications, attendance will be granted based on pre-qualification.

Prerequisites
Required for the participation in the examination is the preparation of a report during the semester. The partial service with the code T-MACH-108888 must have been passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-108888 - Simulation of Coupled Systems - Advance must have been passed.

Recommendation

- Knowledge of ProE (ideally in actual version)
- Basic kniwledge of Matlab/Simulink
- Basic knowledge of dynamics of machnies
- Basic knowledge of hydraulics

Annotation
After completion of course, students are able to:

- build a coupled simulation
- parametrize models
- perform simulations
- conduct troubleshooting
- check results for plausibility

The number of participants is limited.

Content:

- Basics of multi-body and hydralics simulation programs
- Possibilities of coupled simulations
- Modelling and Simulation of Mobile Machines using a wheel loader
- Documentation of the result in a short report

Literature:

Software guide books (PDFs)

Information about wheel-type loader specifications

Below you will find excerpts from events related to this course:

V	**Simulation of Coupled Systems** 2114095, SS 2019, 2 SWS, Language: German, **Open in study portal**	**Lecture (V)**

Learning Content

- Knowledge of the basics of multi-body and hydraulic simulation programs
- Possibilities of coupled simulations
- Development of a simulation model by using the example of a wheel loader
- Documentation of the result in a short report

Workload

- regular attendance: 21 hours
- total self-study: 92 hours

Literature
Elective literature:

- miscellaneous guides according the software-tools pdf-shaped
- information to the wheel-type loader

T 3.301 Course: Simulation of Coupled Systems - Advance [T-MACH-108888]

Responsible: Prof. Dr.-Ing. Marcus Geimer
Yusheng Xiang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Completed coursework	0	Each summer term	1

Exams				
SS 2019	76-T-MACH-108888	Simulation of Coupled Systems - Advance	Prüfung (PR)	Geimer
WS 19/20	76-T-MACH-108888	Simulation of Coupled Systems - Advance	Prüfung (PR)	Geimer

Competence Certificate
Preparation of semester report

Prerequisites
none

T 3.302 Course: Simulator Exercises Combined Cycle Power Plants [T-MACH-105445]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	2	Each summer term	1

Events					
SS 2019	2170491	Simulator Exercises Combined Cycle Power Plants	2 SWS	Practical course (P)	Schulenberg
Exams					
SS 2019	76-T-MACH-105445	Simulator Exercises Combined Cycle Power Plants		Prüfung (PR)	Schulenberg

Competence Certificate
oral exam (ca. 15 min)

Prerequisites
none

Recommendation
Participation at LV-No. 2170490 "Combined Cycle Power Plants" (T-MACH-105444) is recommended.

Below you will find excerpts from events related to this course:

V Simulator Exercises Combined Cycle Power Plants

2170491, SS 2019, 2 SWS, Language: English, Open in study portal

Practical course (P)

Description
Media:

The power plant simulator is based on the control system of a real SIEMENS power plant. The English user surface is based on US standard.

Notes
The training objective of the course is the qualification for a research-related professional activity in power plant engineering. On the basis of the learned fundamentals in thermodynamics, in instrumentation and control engineering, as well as on the basis of the acquired knowledge of design of combined cycle plants, the participants can operate a real combined cycle power plant. This application creates a deeper understanding of the dynamic processes of the power plant, the specific importance of the plant components and the limits of the load capacity of the components. Participants can optimize normal operation and analyze incidents. They can work self-organized and reflexive. They have communicative and organizational skills in teamwork, even under major technical challenges.

Start-up of the power plant from scratch; load changes and shut down; dynamic response of the power plant in case of malfuctions and of sudden load changes; manual operation of selected components.

Learning Content
Start-up of the power plant from scratch; load changes and shut down; dynamic response of the power plant in case of malfuctions and of sudden load changes; manual operation of selected components.

Annotation
Recommendation: Participation at the lecture Combined Cycle Power Plants (2170490) is recommended.

Workload

Regular attendance: 20 hours

Self study: 40 hours

Literature

Slides and other documents of the lecture Combined Cycle Power Plants.

T 3.303 Course: Solar Thermal Energy Systems [T-MACH-106493]

Responsible: Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2189400	Solar Thermal Energy Systems	2 SWS	Lecture (V)	Dagan
Exams					
SS 2019	76-T-MACH-106493	Solar Thermal Energy Systems		Prüfung (PR)	Dagan, Stieglitz
WS 19/20	76-T-MACH-106493	Solar Thermal Energy Systems		Prüfung (PR)	Dagan, Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Recommendation
Literature

1. "Solar Engineering of Thermal Processes", 4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons
2. “Heat Transfer”, 10th Edition, J. P. Holman Mc. Graw Hill publisher
3. “Fundamentals of classical Thermodynamics”, G. Van Wylen & R. E. Sonntag. Published by Wiley &Sons

Below you will find excerpts from events related to this course:

V Solar Thermal Energy Systems

Lecture (V)

2189400, WS 19/20, 2 SWS, Language: English, Open in study portal

Notes

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun’s structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

The students get familiar with the global energy demand and the role of renewable energies learn about improved designs for using efficiently the potential of solar energy gain basic understanding of the main thermal hydraulic phenomena which support the work on future innovative applications will be able to evaluate quantitatively various aspects of the thermal solar systems.

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

oral exam about 30 min.

Learning Content

The course deals with fundamental aspects of solar energy

1. Introduction to solar energy – global energy panorama

2. Solar energy resource-

Structure of the sun, Black body radiation, solar constant, solar spectral distribution

Sun-Earth geometrical relationship

3. Passive and active solar thermal applications.

4. Solar thermal systems- solar collector-types, concentrating collectors, solar towers,

Heat losses, efficiency

5. Selected topics on thermodynamics and heat transfer which are relevant for solar systems.

6. Introduction to Solar induced systems: Wind , Heat pumps, Biomass , Photovoltaic

7. Energy storage

The course deals with fundamental aspects of solar energy. Starting from a global energy panorama the course deals with the sun as a thermal energy source. In this context, basic issues such as the sun’s structure, blackbody radiation and solar–earth geometrical relationship are discussed. In the next part, the lectures cover passive and active thermal applications and review various solar collector types including concentrating collectors and solar towers and the concept of solar tracking. Further, the collector design parameters determination is elaborated, leading to improved efficiency. This topic is augmented by a review of the main laws of thermodynamics and relevant heat transfer mechanisms.

The course ends with an overview on energy storage concepts which enhance practically the benefits of solar thermal energy systems.

Workload

Total 120 h, hereof 30 h contact hours and 90 h homework and self-studies

T 3.304 Course: Solid State Reactions and Kinetics of Phase [T-MACH-107667]

Responsible: Dr. Peter Franke
Prof. Dr. Hans Jürgen Seifert

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	3

Events					
WS 19/20	2193003	Solid State Reactions and Kinetics of Phase Transformations (with exercises)	2 SWS	Lecture (V)	Franke
Exams					
SS 2019	76-T-MACH-107667	Solid State Reactions and Kinetics of Phase		Prüfung (PR)	Seifert, Franke

Competence Certificate
oral examination (about 30 min)

Prerequisites
The successful participation in Exercises for Solid State Reactions and Kinetics of Phase Transformations is the condition for the admittance to the oral exam in Solid State Reactions and Kinetics of Phase.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must have been passed.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physical chemistry

Below you will find excerpts from events related to this course:

V Solid State Reactions and Kinetics of Phase Transformations (with exercises)

Lecture (V)

2193003, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

Oral examination (about 30 min)

Teaching Content:

1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

Recommendations:

knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert); Bacic course in materials science and Engineering; Basic course in mathematics; physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students acquire knowledge about:

- diffusion mechanisms
- Fick's laws
- basic solutions of the diffusion equation
- evaluation of diffusion experiments
- interdiffusion processes
- the thermodynamic factor
- parabolic growth of layers
- formation of pearlite
- microstructural transformations according to the models of Avrami and Johnson-Mehl
- TTT diagrams

Learning Content

1. Crystal Defects and Mechanisms of Diffusion
2. Microscopic Description of Diffusion
3. Phenomenological Treatment
4. Diffusion Coefficients
5. Diffusion Problems; Analytical Solutions
6. Diffusion with Phase Transformation
7. Kinetics of Microstructural Transformations
8. Diffusion at Surfaces, Grain Boundaries and Dislocations
9. Numerical treatment of diffusion controlled phase transformations

Workload

regular attendance: 22 hours

self-study: 98 hours

Literature

1. J. Crank, "The Mathematics of Diffusion", 2nd Ed., Clarendon Press, Oxford, 1975.
2. J. Philibert, "Atom Movements", Les Éditions de Physique, Les Ulis, 1991.
3. D.A. Porter, K.E. Easterling, M.Y. Sherif, "Phase Transformations in Metals and Alloys", 3rd edition, CRS Press, 2009.
4. H. Mehrer, "Diffusion in Solids", Springer, Berlin, 2007.

T 3.305 Course: Strategic product development - identification of potentials of innovative products [T-MACH-105696]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Andreas Siebe

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	2

Events					
SS 2019	2146198	Strategic product development - identification of potentials of innovative products	2 SWS	Lecture (V)	Siebe
Exams					
SS 2019	76-T-MACH-105696	Strategic product development - identification of potentials of innovative products		Prüfung (PR)	Siebe, Albers

Competence Certificate
Oral exam in small groups (30 minutes)

Prerequisites
The precondition of this partial work is the successful processing of a case study(T-MACH-110396): written elaboration & presentation of the results (15 minutes)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110396 - Strategic product development - identification of potentials of innovative products - Case Study must have been passed.

Below you will find excerpts from events related to this course:

V Strategic product development - identification of potentials of innovative products **Lecture (V)**
2146198, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
Introduction into future management, Development of scenarios, scenariobased strategy development, trendmanagement, strategic early detection, innovation- and technologymanagement, scenarios in product development, from profiles of requirements to new products, examples out of industrial praxis.

Workload
regular attendance: 21 h

self-study: 99 h

T 3.306 Course: Structural Analysis of Composite Laminates [T-MACH-105970]

Responsible: Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2113106	Structural Analysis of Composite Laminates	2 SWS	Lecture (V)	Kärger

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural Analysis of Composite Laminates

2113106, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Literature

H. Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

E. J. Barbero: Finite Element Analysis of Composite Materials. ISBN: 1-4200-5433-3. CRC Press, Boca Raton, FL, 1. edition, 2008.

E. J. Barbero: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

E. J. Barbero: Finite Element Analysis of Composite Materials Using Abaqus. ISBN: ISBN: 978-1-46-651661-8. CRC Press, Boca Raton, FL, 2013.

Isaac M. Daniel, Ori Ishai: Engineering Mechanics of Composite Materials. Oxford Univ Press; ISBN-13: 978-0195150971, 2. Edition, 2005.

Davila, C. G.; Camanho, P. P.; Rose, C. A.: Failure criteria for FRP laminates. Journal of Composite Materials 39: 323-345, 2005.

Hinton, M. J.; Kaddour, A. S.; Soden, P. D.: A comparison of the predictive capabilities of current failure theories for composite laminates, judged against experimental evidence. Composites Science and Technology 62: 1725-1797, 2002.

Puck, A.; Schürmann, H.: Failure analysis of FRP laminates by means of physically based phenomenological models. Composite Science and Technology 58: 1045-1067, 1998.

Reddy, J. N.: Mechanics of laminated composite plates and shells - Theory and Analysis. USA: CRC Press, Boca Raton, 2004.

Soden, P. D.; Kaddour, A. S.; Hinton, M. J.: Recommendations for designers and researchers resulting from the world-wide failure exercise. Composites Science and Technology 64: 589-604, 2004.

Stephen W. Tsai and J. Daniel D. Melo: Composite Materials Design and Testing. Composites Design Group, 978-0-9860845-1-5 Stanford University , 2015.

T 3.307 Course: Structural Ceramics [T-MACH-102179]

Responsible: Prof. Dr. Michael Hoffmann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2126775	Structural Ceramics	2 SWS	Lecture (V)	Hoffmann
Exams					
SS 2019	76-T-MACH-102179	Structural Ceramics		Prüfung (PR)	Hoffmann, Wagner, Schell
WS 19/20	76-T-MACH-102179	Structural Ceramics		Prüfung (PR)	Hoffmann, Wagner, Schell

Competence Certificate
Oral examination, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural Ceramics
2126775, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Slides for the lecture:

available under http://www.iam.kit.edu/km

Learning Content
The lecture gives an overview on structure and properties of the technical relevant structural ceramics silicon nitride, silicon carbide, alumina, zirconia, boron nitride and fibre-reinforced ceramics. All types of structural ceramics will be discussed in detail in terms of preparation methods of the raw materials, shaping techniques, densification, microstructural development, mechanical properties and application fields.

Annotation
The course will not take place every year.

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature
W.D. Kingery, H.K. Bowen, D.R. Uhlmann, "Introduction to Ceramics", John Wiley & Sons, New York, (1976)

E. Dörre, H. Hübner, "Aluminia", Springer Verlag Berlin, (1984)

M. Barsoum, "Fundamentals of Ceramics", McGraw-Hill Series in Material Science and Enginewering (2003)

T 3.308 Course: Structural Materials [T-MACH-100293]

Responsible: Dr.-Ing. Stefan Guth
Dr. Karl-Heinz Lang

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2019	2174580	Structural Materials	4 SWS	Lecture / Practice (VÜ)	Lang
Exams					
SS 2019	76-T-MACH-100293	Structural Materials		Prüfung (PR)	Lang, Guth
WS 19/20	76-T-MACH-100293	Structural Materials		Prüfung (PR)	Lang, Guth

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Structural Materials
2174580, SS 2019, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes
Lectures and tutorialy on the topics:

- basic loading types and superimposed loadings
- high-temperature loading
- influence of notches
- uniaxial, multiaxial and superimposed cyclic loading
- notch fatigue
- structural durability
- impact of residual stresses
- basic principles of materials selection
- dimensioning of components

learning objectives:
The students are able to select materials for mechanical design and to dimension structural components according to the state of the art. They are familiar with the most important engineering materials. They can assess these materials on base of their characteristic properties and and they can match property profiles and requirement profiles. The dimensioning includes complex situations, such as multiaxial loading, notched components, static and dynamic loading, componetns with residual stresses and loading at high homologous temperatures.

requirements:
none

workload:

Precence: 42h

Self study: 138h

Learning Content
Lectures and tutorialy on the topics:

- basic loading types and superimposed loadings
- high-temperature loading
- influence of notches
- uniaxial, multiaxial and superimposed cyclic loading
- notch fatigue
- structural durability
- impact of residual stresses
- basic principles of materials selection
- dimensioning of components

Workload
Precence: 42h

Self study: 138h

T 3.309 Course: Superconducting Materials for Energy Applications [T-ETIT-106970]

Responsible: Dr. Francesco Grilli
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2312682	Superconducting Materials for Energy Applications	2 SWS	Lecture (V)	Grilli
SS 2019	2312692	Übungen zu 2312682 Superconducting Materials for Energy Applications	1 SWS	Practice (Ü)	Grilli
Exams					
SS 2019	7312682	Superconducting Materials for Energy Applications		Prüfung (PR)	Grilli
SS 2019	7312685	Superconducting Materials for Energy Applications (2nd Exam)		Prüfung (PR)	Grilli

Prerequisites
none

Recommendation
Basic knowledge in the fields of Electrical Engineering and Thermodynamics is helpful.

Annotation
Exam and Lecture will be held in English.

Elective Course in other Fields of Study.

T 3.310 Course: Superhard Thin Film Materials [T-MACH-102103]

Responsible: Prof. Dr. Sven Ulrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2177618	Superhard Thin Film Materials	2 SWS	Lecture (V)	Ulrich
Exams					
SS 2019	76-T-MACH-102103	Superhard Thin Film Materials		Prüfung (PR)	Ulrich

Competence Certificate
oral examination (ca. 30 Minuten)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Superhard Thin Film Materials — **Lecture (V)**
2177618, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
oral examination (about 30 min), no tools or reference materials

Teaching Content:

Introduction

Basics

Plasma diagnostics

Particle flux analysis

Sputtering and ion implantation

Computer simulations

Properties of materials, thin film deposition technology,
thin film analysis and modelling of superhard materials

Amorphous hydrogenated carbon

Diamond like carbon

Diamond

Cubic Boronnitride

Materials of the system metall-boron-carbon-nitrogen-silicon

regular attendance: 22 hours
self-study: 98 hours

Superhard materials are solids with a hardness higher than 4000 HV 0,05. The main topics of this lecture are modelling, deposition, characterization and application of superhard thin film materials.

Learning Content
Introduction

Basics

Plasma diagnostics

Particle flux analysis

Sputtering and ion implantation

Computer simulations

Properties of materials, thin film deposition technology,
thin film analysis and modelling of superhard materials

Amorphous hydrogenated carbon

Diamond like carbon

Diamond

Cubic Boronnitride

Materials of the system metall-boron-carbon-nitrogen-silicon

Workload
regular attendance: 22 hours
self-study: 98 hours

Literature
G. Kienel (Ed.): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Copies with figures and tables will be distributed

T 3.311 Course: Supply Chain Management [T-MACH-105181]

Responsible: Dr.-Ing. Knut Alicke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Competence Certificate
The assessment consists of an oral exam (20 min.) taking place in the recess period according to § 4 paragraph 2 Nr. 2 of the examination regulation.

Prerequisites
none

T 3.312 Course: Sustainable Product Engineering [T-MACH-105358]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr. Karl-Friedrich Ziegahn

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2146192	Sustainable Product Engineering	2 SWS	Lecture (V)	Ziegahn

Competence Certificate
written exam (60 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V Sustainable Product Engineering

2146192, SS 2019, 2 SWS, Open in study portal

Lecture (V)

Description
Media

- Beamer

Learning Content
understanding of sustainability objectives and their role in product development, the interaction between technical products and their environment, the holistic approach and the equality of economic, social and environmental aspects and environmental aspects

skills for life-cycle product design using the example of complex automotive components such as airbag systems and other current products

understanding of product environmental stresses with relevancy to praxis at the example of technology-intensive components, robustness and durability of products as the basis for a sustainable product development, development of skills for the application of environmental simulationduring the process of developement of technical products

delivery of key skills such as team skills / project / self / presentation based on realistic projects

Workload
regular attendance: 21 h

self-study: 99 h

T 3.313 Course: System Dynamics and Control Engineering [T-ETIT-101921]

Responsible: Prof. Dr.-Ing. Sören Hohmann
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	6	Each summer term	1

Events					
SS 2019	2303155	Systemdynamik und Regelungstechnik	3 SWS	Lecture (V)	Hohmann
SS 2019	2303157	Übungen zu 2303155 Systemdynamik und Regelungstechnik	1 SWS	Practice (Ü)	Kölsch
SS 2019	2303701	Tutorien zu 2303155 SRT	SWS	Tutorial (Tu)	Kölsch
Exams					
SS 2019	7303155	System Dynamics and Control Engineering		Prüfung (PR)	Hohmann

Prerequisites
none

T 3.314 Course: System Integration in Micro- and Nanotechnology [T-MACH-105555]

Responsible: Dr. Ulrich Gengenbach
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2106033	System Integration in Micro- and Nanotechnology	2 SWS	Lecture (V)	Gengenbach
Exams					
SS 2019	76-T-MACH-105555	System Integration in Micro- and Nanotechnology		Prüfung (PR)	Gengenbach

Competence Certificate
oral exam (Duration: 30 min)

Prerequisites
none

Below you will find excerpts from events related to this course:

V System Integration in Micro- and Nanotechnology

2106033, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Content:

- Introduction
- Definition system integration
- Integration of mechanical functions (flexures)
- Plasma treatment of surfaces
- Adhesive bonding
    - Packaging
    - Low Temperature Cofired Ceramics (LTCC)
    - Assembly of hybrid systems

- Monolithic/hybrid system integration)
- Modular system integration

- Integration of electrical/electronic functions
- Mounting techniques
- molded Interconnect Devices (MID)
- Functional printing

- Coating
- Capping
- Housing

First steps towards system integration nanotechnology

Learning objectives:

Students acquire fundamental knowledge about challenges and system integration processes.

Learning Content

- Introduction
- Definition system integration
- Integration of mechanical functions (flexures)
- Plasma treatment of surfaces
- Adhesive bonding
    - Packaging
    - Low Temperature Cofired Ceramics (LTCC)
    - Assembly of hybrid systems

- Monolithic/hybrid system integration)
- Modular system integration

- Integration of electrical/electronic functions
- Mounting techniques
- molded Interconnect Devices (MID)
- Functional printing

- Coating
- Capping
- Housing

First steps towards system integration nanotechnology

Literature

- A. Risse, Fertigungsverfahren der Mechatronik, Feinwerk- und Präzisionsgerätetechnik, Vieweg+Teubner Verlag Wiesbaden, 2012
- M. Madou, Fundamentals of microfabrication and nanotechnology, CRC Press Boca raton, 2012
- G. Habenicht, Kleben Grundlagen, Technologien, Anwendungen, Springer-Verlag Berlin Heidelberg, 2009
- J. Franke, Räumliche elektronische Baugruppen (3D-MID), Carl Hanser-Verlag München, 2013

T 3.315 Course: Systematic Materials Selection [T-MACH-100531]

Responsible: Dr.-Ing. Stefan Dietrich
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	3

Events					
SS 2019	2174576	Systematic Materials Selection	3 SWS	Lecture (V)	Dietrich
SS 2019	2174577	Übungen zu 'Systematische Werkstoffauswahl'	1 SWS	Practice (Ü)	Dietrich, Mitarbeiter
Exams					
SS 2019	76-T-MACH-100531	Systematic Materials Selection		Prüfung (PR)	Dietrich
WS 19/20	76-T-MACH-100531	Systematic Materials Selection		Prüfung (PR)	Dietrich

Competence Certificate
The assessment is carried out as a written exam of 2 h.

Prerequisites
none

Recommendation
Basic knowledge in materials science, mechanics and mechanical design due to the lecture Materials Science I/II.

Below you will find excerpts from events related to this course:

V Systematic Materials Selection
2174576, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Notes
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are deeloped. The following topics are covered:

- Information and introduction
- Necessary basics of materials
- Selected methods / approaches of the material selection
- Examples for material indices and materials property charts
- Trade-off and shape factors
- Sandwich materials and composite materials
- High temperature alloys
- Regard of process influences
- Material selection for production lines
- Incorrect material selection and the resulting consequences
- Abstract and possibility to ask questions

learning objectives:
The students are able to select the best material for a given application. They are proficient in selecting materials on base of performance indices and materials selection charts. They can identify conflicting objectives and find sound compromises. They are aware of the potential and the limits of hybrid material concepts (composites, bimaterials, foams) and can determine whether following such a concept yields a useful benefit.
requirements:

WiIng SPO 2007 (B.Sc.)

The course Material Science I [21760] has to be completed beforehand.

WiIng (M.Sc.)

The course Material Science I [21760] has to be completed beforehand.

workload:

The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Learning Content
Important aspects and criteria of materials selection are examined and guidelines for a systematic approach to materials selection are deeloped. The following topics are covered:

- Information and introduction
- Necessary basics of materials
- Selected methods / approaches of the material selection
- Examples for material indices and materials property charts
- Trade-off and shape factors
- Sandwich materials and composite materials
- High temperature alloys
- Regard of process influences
- Material selection for production lines
- Incorrect material selection and the resulting consequences
- Abstract and possibility to ask questions

Workload
The workload for the lecture is 120 h per semester and consists of the presence during the lecture (30 h) as well as preparation and rework time at home (30 h) and preparation time for the oral exam (60 h).

Literature
Lecture notes; Problem sheets; Textbook: M.F. Ashby, A. Wanner (Hrsg.), C. Fleck (Hrsg.);
Materials Selection in Mechanical Design: Das Original mit Übersetzungshilfen
Easy-Reading-Ausgabe, 3. Aufl., Spektrum Akademischer Verlag, 2006
ISBN: 3-8274-1762-7

T 3.316 Course: Systems Engineering for Automotive Electronics [T-ETIT-100677]

Responsible: Dr.-Ing. Jürgen Bortolazzi
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Version
Written examination	4	1

Events					
SS 2019	2311642	Systems Engineering for Automotive Electronics	2 SWS	Lecture (V)	Bortolazzi
SS 2019	2311644	Systems Engineering for Automotive Electronics (Tutorial)	1 SWS	Practice (Ü)	Pistorius
Exams					
SS 2019	7311642	Systems Engineering for Automotive Electronics		Prüfung (PR)	Bortolazzi

Prerequisites
none

T 3.317 Course: Technical Design in Product Development [T-MACH-105361]

Responsible: Prof. Dr.-Ing. Albert Albers
Prof. Dr.-Ing. Sven Matthiesen
Dr.-Ing. Markus Schmid

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2146179	Technical Design in Product Development	2 SWS	Lecture (V)	Schmid
Exams					
SS 2019	7600018	Technical Design in Product Development		Prüfung (PR)	Schmid
SS 2019	7600021	Technical Design in Product Development		Prüfung (PR)	Schmid

Competence Certificate
Written exam (20 min)

Only dictionnary is allowed

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technical Design in Product Development — Lecture (V)
2146179, SS 2019, 2 SWS, Language: German, Open in study portal

Description
Media:

- Beamer
- Models

Learning Content
Introduction
Relevant parameters on product value in Technical Design
Design in Methodical Development and Engineering and for a differentiated validation of products
Design in the concept stage of Product Development
Design in the draft and elaboration stage of Product Development

Workload
regular attendance: 21 h

self-study: 99 h

Literature
Hexact (R) Lehr- und Lernportal

T 3.318 Course: Technical Energy Systems for Buildings 1: Processes & Components [T-MACH-105559]

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2157200	Technical energy systems for buildings 1: Processes & components	2 SWS	Lecture (V)	Schmidt
Exams					
WS 19/20	76-T-MACH-105559	Technical Energy Systems for Buildings 1: Processes & Components		Prüfung (PR)	Schmidt

Competence Certificate
oral exam, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technical energy systems for buildings 1: Processes & components

Lecture (V)

2157200, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes
Introduction to heating and cooling technologies for buildings, solar energy utilization in buildings (solar radiation, solar thermal energy, photovoltaics) and to energy storage in buildings (thermal and electric storage technologies). Topics covered:

- Burners, condensing and non-condensing boilers
- Cogeneration units for use in buildings
- Heat transformation: Fundamentals, vapor compression, absorption, adsorption
- Solar energy: Radiation, solar thermal collectors, photovoltaics
- energy storage in buildings: thermal and electric storage

Learning objectives:

Students know relevant technical components of energy supply systems in buildings (heating and cooling, dehumidification). They know the energy conversion processes associated with these components and can estimate their energy efficiencies as well as the most important factors influencing efficiency.

Students are familiar with the underlying physics (mostly thermodynamics) of the relevant processes. They can derive relevant figures of merit from these principles. They know the degree of technological development for the various processes and components and are aware of current research and development objectives in this field.

Oral exam: about 25 min.
No tools

T 3.319 Course: Technical Energy Systems for Buildings 2: System Concept [T-MACH-105560]

Responsible: Dr. Ferdinand Schmidt
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2158201	Technical energy systems for buildings 2: System concepts	2 SWS	Lecture (V)	Schmidt
Exams					
WS 19/20	76-T-MACH-105560	Technical Energy Systems for Buildings 2: System Concept		Prüfung (PR)	Schmidt

Competence Certificate
oral exam, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technical energy systems for buildings 2: System concepts

Lecture (V)

2158201, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
Introduction of relevant figures of merit for technical energy systems in buildings. Description of different system concepts for energy supply of buildings (heating, cooling, dehumidification) and evaluation according to figures of merit. Systems covered include

- Heat pumps and heat pump systems including combination with solar thermal energy
- cogeneration and trigeneration system (heating, cooling, power)
- Solar thermal systems: Domestic hot water, heating support, cooling and dehumidification
- District heating systems including solar thermal heat
- Photovoltaics and heat pump systems including thermal and battery storage
- Grid-reactive building technology: Smart-Metering, Smart Home, Smart Grid

Learning outcomes:

Students are able to develop system concepts for technical energy systems in buildings and to rationally design such systems. They know the relevant figures of merit for an energy-related as well as an economical or combined evaluation of systems, and know how to employ these figures of merit in sizing systems and components. Students are able to employ plausibility checks and to give rough estimates on building energy concepts and they know which technologies can be combined for highly efficient system combinations.

Workload: 30 hours course attendance, 90 hours self-study

Oral exam appr. 25 minutes

T 3.320 Course: Technical Thermodynamics and Heat Transfer I [T-MACH-104747]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	8	Each winter term	2

Events					
WS 19/20	2165501	Technical Thermodynamics and Heat Transfer I	4 SWS	Lecture (V)	Maas
WS 19/20	3165014	Technical Thermodynamics and Heat Transfer I	4 SWS	Lecture (V)	Schießl, Maas
Exams					
SS 2019	76-T-MACH-104747	Technical Thermodynamics and Heat Transfer I		Prüfung (PR)	Maas
SS 2019	76-T-MACH-104747-englisch	Technical Thermodynamics and Heat Transfer I		Prüfung (PR)	Maas

Competence Certificate
Written exam [duration: 180 min]

Prerequisites
Successful participation in the tutorial (T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105204 - Excercises in Technical Thermodynamics and Heat Transfer I must have been passed.

Below you will find excerpts from events related to this course:

V Technical Thermodynamics and Heat Transfer I — Lecture (V)
2165501, WS 19/20, 4 SWS, Language: German, Open in study portal

Description
Media:

Blackboard and Powerpoint presentation

Learning Content
System, properties of state
Absolute temperature, model systems
1st law of thermodynamics for resting and moving systems
Entropy and 2nd law of thermodynamics
Behavior of real substances described by tables, diagrams and equations of state
Machine processes

Workload
Regular attendance: 56.3 h

Self-study: 183.8 h

Literature
Lecture notes

Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.

Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

T 3.321 Course: Technical Thermodynamics and Heat Transfer II [T-MACH-105287]

Responsible: Prof. Dr. Ulrich Maas
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Written examination	7	Each summer term	1

Events					
SS 2019	2166526	Technical Thermodynamics and Heat Transfer II	3 SWS	Lecture (V)	Maas
SS 2019	3166526	Technical Thermodynamics and Heat Transfer II	3 SWS	Lecture (V)	Schießl
Exams					
SS 2019	76-T-MACH-105287	Technical Thermodynamics and Heat Transfer II		Prüfung (PR)	Maas
SS 2019	76-T-MACH-105287-englisch	Technical Thermodynamics and Heat Transfer II		Prüfung (PR)	Maas

Competence Certificate
Written exam [duration: 180 min]

Prerequisites
Successful participation in the tutorial (T-MACH-105288 - Exercises in Technical Thermodynamics and Heat Transfer II)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105288 - Excercises in Technical Thermodynamics and Heat Transfer II must have been passed.

Below you will find excerpts from events related to this course:

V Technical Thermodynamics and Heat Transfer II

Lecture (V)

2166526, SS 2019, 3 SWS, Language: German, Open in study portal

Description
Media:

Blackboard and Powerpoint presentation

Learning Content
Repetition of the topics of "Thermodynamics and Heat Transfer I"
Mixtures of ideal gases
Moist air
Behaviour of real substances described by equations of state
Applications of the laws of thermodynamics to chemical reactions

Workload
Regular attendance: 52,5 hours

Self-study: 142,5 hours

Literature

Course notes

Elsner, N.; Dittmann, A.: Energielehre und Stoffverhalten (Grundlagen der technischen Thermodynamik Bd. 1 und 2), 8. Aufl., Akademie-Verlag, 680 S. 1993.

Baehr, H.D.: Thermodynamik: eine Einführung in die Grundlagen und ihre technischen Anwendungen, 9. Aufl., Springer-Verlag, 460 S., 1996.

T 3.322 Course: Technology of Steel Components [T-MACH-105362]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	2

Events					
SS 2019	2174579	Technology of steel components	2 SWS	Lecture (V)	Schulze
Exams					
SS 2019	76-T-MACH-105362	Technology of Steel Components		Prüfung (PR)	Schulze

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Technology of steel components — Lecture (V)
2174579, SS 2019, 2 SWS, Language: German, Open in study portal

Notes
Meaning, Development and characterization of component states

Description of the influence of component state on mechanical properties

Stability of component states

Steel manufacturing

Component states due to forming

Component states due to heat treatments

Component states due to surface hardening

Component states due to machining

Component states due to mechanical surface treatments

Component states due to joining

Summarizing evaluation

learning objectives:
The students have the background to evaluate the influence of manufacture processes on the compound state of metallic compounds. The students can assess the influence and the stability of compound state under mechanical load. The students are capable to describe the individual aspects of interaction of the compound state of steel components due to forming, heat treatment, mechanical surface treatment and joining processes.
requirements:
Materials Science and Engineering I & II
workload:

regular attendance: 21 hours
self-study: 99 hours

Learning Content

Meaning, Development and characterization of component states

Description of the influence of component state on mechanical properties

Stability of component states

Steel manufacturing

Component states due to forming

Component states due to heat treatments

Component states due to surface hardening

Component states due to machining

Component states due to mechanical surface treatments

Component states due to joining

Summarizing evaluation

Workload

regular attendance: 21 hours
self-study: 99 hours

Literature

Script will be distributed within the lecture

VDEh: Werkstoffkunde Stahl, Bd. 1: Grundlagen, Springer-Verlag, 1984

H.-J. Eckstein: Technologie der Wärmebehandlung von Stahl, Deutscher Verlag Grundstoffindustrie, 1977

H.K.D.H. Badeshia, R.W.K. Honeycombe, Steels - Microstructure and Properties, CIMA Publishing, 3. Auflage, 2006

V. Schulze: Modern Mechanical Surface Treatments, Wiley, Weinheim, 2005

T 3.323 Course: Ten Lectures on Turbulence [T-MACH-105456]

Responsible: Dr. Ivan Otic
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189904	Ten lectures on turbulence	2 SWS	Lecture (V)	Otic
Exams					
SS 2019	76-T-MACH-105456	Ten Lectures on Turbulence		Prüfung (PR)	Otic
WS 19/20	76-T-MACH-105456	Ten Lectures on Turbulence		Prüfung (PR)	Otic

Competence Certificate
oral exam, 20 min

Prerequisites
none

Below you will find excerpts from events related to this course:

V Ten lectures on turbulence
2189904, WS 19/20, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
1 Introduction
2 Turbulent transport of momentum and heat
3 Statistical description of turbulence
4 Scales of turbulent flows
5 Homogeneous turbulent shear flows
6 Free turbulent shear flows
7 Wall-Bounded turbulent flows
8 Turbulence Modelling
9 Reynolds Averaged Navier-Stokes (RANS) Simulation Approach
10 Large Eddy Simulation (LES) Approach

Learning Content
1 Introduction
2 Turbulent transport of momentum and heat
3 Statistical description of turbulence
4 Scales of turbulentfl ows
5 Homogeneous turbulent shear ows
6 Free turbulent shear flows
7 Wall-Bounded turbulent flows
8 Turbulence Modelling
9 Reynolds Averaged Navier-Stokes (RANS) Simulation Approach
10 Large Eddy Simulation (LES) Approach

Workload
Time of attendence: 25 hours

Self-study: 100 hours

Literature
Reference texts:
- Lecture Notes
- Presentation slides

Recommended Books:
- Pope, S. B.: Turbulent Flows. Cambridge University Press , 2003.
- Hinze J. O.: Turbulence. McGraw-Hill, 1975.

T 3.324 Course: Theory of Probability [T-ETIT-101952]

Responsible: Dr.-Ing. Holger Jäkel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-104882 - Courses of the Department of Electrical Engineering and Information Technology

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	1

Events					
WS 19/20	2310505	Theory of Probability	2 SWS	Lecture (V)	Jäkel
WS 19/20	2310507	Tutorial for 2310505 Theory of Probability	1 SWS	Practice (Ü)	Müller
Exams					
SS 2019	7310505	Theory of Probability		Prüfung (PR)	Jäkel

Prerequisites
none

T 3.325 Course: Theory of Stability [T-MACH-105372]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	1

Events					
SS 2019	2163113	Theory of Stability	2 SWS	Lecture (V)	Fidlin
SS 2019	2163114	Übungen zu Stabilitätstheorie	2 SWS	Practice (Ü)	Fidlin, Schröders
Exams					
SS 2019	76-T-MACH-105372	Theory of Stability		Prüfung (PR)	Fidlin

Competence Certificate
oral exam, 30 min.

Prerequisites
none

Recommendation
Vibration theory, Mathematical Methods of Vibration Theory

Below you will find excerpts from events related to this course:

V Theory of Stability

2163113, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content

- Basic concepts of stability
- Lyapunov's functions
- Direct lyapunov's methods
- Stability of equilibria positions
- Attraction area of a stable solution
- Stability according to the first order approximation
- Systems with parametric excitation
- Stability criteria in the control theory

Workload
time of attendance: 39 h
self-study: 201 h

Literature

- Pannovko Y.G., Gubanova I.I. Stability and Oscillations of Elastic Systems, Paradoxes, Fallacies and New Concepts. Consultants Bureau, 1965.
- Hagedorn P. Nichtlineare Schwingungen. Akademische Verlagsgesellschaft, 1978.
- Thomsen J.J. Vibration and Stability, Order and Chaos. McGraw-Hill, 1997.

T 3.326 Course: Thermal Solar Energy [T-MACH-105225]

Responsible: Prof. Dr. Robert Stieglitz
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169472	Thermal Solar Energy	2 SWS	Lecture (V)	Stieglitz
Exams					
SS 2019	76-T-MACH-105225	Thermal Solar Energy		Prüfung (PR)	Stieglitz
WS 19/20	76-T-MACH-105225	Thermal Solar Energy		Prüfung (PR)	Stieglitz

Competence Certificate
Oral examination, 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal Solar Energy **Lecture (V)**
2169472, WS 19/20, 2 SWS, Language: German, Open in study portal

Notes

Basics of thermal solar energy (radiation, heat conduction, storage, efficiency…) Active and passive use of solar energy. Solar collectors (design types, efficiency, system technology). Solar plants (heliostats etc.). Solar climatisation.

In detail:

1 Introduction to energy requirements and evaluation of the potential use of solar thermal energy.

2 Primary energy source SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).

3 Solar collectors: schematic structure of a collector, fundamentals of efficiency, meaning of concentration and their limitations.

4 Passive solar mechanisms: heat conduction in solids and gases, radiation heat transfer in transparent and opaque bodies, selective absorber - typical materials and manufacturing processes.

5 Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.

optional

6 Low temperature solar thermal systems: collector types, methods for system simulation, planning and dimensioning of systems, system design and stagnation scenarios.

7 High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes

The lecture elaborates the basics of the solar technology and the definition of the major wordings and its physical content such as radiation, thermal use, insulation etc.. Further the design of solar collectors for different purposes is discussed and analyzed. The functional principle of solar plants is elaborated before at the end the ways for solar cooling is discussed.

The aim of the course is to provide the basic physical principles and the derivation of key parameters for the individual solar thermal use. This involves in addition to the selective absorber, mirrors, glasses, and storage technology. In addition, a utilization of solar thermal energy means an interlink of the collector with a thermal-hydraulic circuit and a storage. The goal is to capture the regularities of linking to derive efficiency correlations as a function of their use and evaluate the performance of the entire system.

Recommendations / previous knowledge

Basics in heat and mass transfer, material science and fluid mechanics, desirable are reliable knowledge in physics in optics and thermodynamics

Oral exam of about 25 minutes, no tools or reference materials may be used during the exam

Learning Content

Baiscs of thermal solar energy (radiation, heat conduction, storage, efficiency ….) Active and passive use of solar energy. Solar collectors (design types, efficiency, system technology). Solar plants (heliostats etc.). Solar climatization.

In detail:

1 Introduction to energy requirements and evaluation of the potential use of solar thermal energy.

2 Primary energy sources SUN: sun, solar constant, radiation (direct, diffuse scattering, absorption, impact angle, radiation balance).

3 Solar panels: schematic structure of a collector, fundamentals of efficiency, meaning of concentration and their limitations.

4 Passive solar mechanisms: heat conduction in solids and gases, radiation heat transfer in transparent and opaque bodies, selective absorber - typical materials and manufacturing processes.

5 Momentum and heat transport: basic equations of single and multiphase transport, calculation methods, stability limits.

optional

6 Low temperature solar thermal systems: Collector variants, methods for system simulation, planning and dimensioning of systems, system design and arrest scenarios.

6 High temperature solar thermal systems: solar towers and solar-farm concept, loss mechanisms, chimney power plants and energy production processes

end

- Memory: energy content, storage types, storage materials, cost
- Solar Air Conditioning: Cooling capacity determination, climate, solar cooling method and evaluation of air conditioning.

Workload
regular attendance: 21 h
self-study: 90 h

Literature
supply of lecture material in printed and electronic form

Stieglitz & Heinzel; Thermische Solarenergie -Grundlagen-Technologie- Anwendungen. Springer Vieweg Verlag. 711 Seiten. ISBN 978-3-642-29474-7

T 3.327 Course: Thermal Turbomachines I [T-MACH-105363]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each winter term	1

Events					
WS 19/20	2169453	Thermal Turbomachines I	3 SWS	Lecture / Practice (VÜ)	Bauer
WS 19/20	2169454	Tutorial - Thermal Turbo Machines I (Übungen zu Thermische Turbomaschinen I)	2 SWS	Practice (Ü)	Bauer
WS 19/20	2169553	Thermal Turbomachines I (in English)	3 SWS	Lecture / Practice (VÜ)	Bauer
Exams					
SS 2019	76-T-MACH-105363	Thermal Turbomachines I		Prüfung (PR)	Bauer

Competence Certificate
oral exam, duration 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal Turbomachines I

2169453, WS 19/20, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Learning Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (available via Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

V **Thermal Turbomachines I (in English)** **Lecture / Practice (VÜ)**
2169553, WS 19/20, 3 SWS, Language: English, Open in study portal

Learning Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (available via Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T 3.328 Course: Thermal Turbomachines II [T-MACH-105364]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	6	Each summer term	2

Events					
SS 2019	2170476	Thermal Turbomachines II	3 SWS	Lecture (V)	Bauer
SS 2019	2170477	Tutorial - Thermal Turbomachines II (Übung - Thermische Turbomaschinen II)	2 SWS	Practice (Ü)	Bauer, Mitarbeiter
SS 2019	2170553	Thermal Turbomachines II (in English)	3 SWS	Lecture / Practice (VÜ)	Bauer, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105364	Thermal Turbomachines II		Prüfung (PR)	Bauer

Competence Certificate
oral exam, duration: 30 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal Turbomachines II

2170476, SS 2019, 3 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
General overview, trends in design and development

Comparison turbine - compressor

Integrating resume of losses

Principal equations and correlations in turbine and compressor design, stage performance

Off-design performance of multi-stage turbomachines

Control system considerations for steam and gas turbines

Components of turbomachines

Critical components

Materials for turbine blades

Cooling methods for turbine blades (steam and air cooling methods)

Short overview of power plant operation

Combustion chamber and environmental issues

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (Available via internet)
Bohl, W.: Strömungsmaschinen, Bd. I,II, Vogel Verlag 1990, 1991
Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993
Traupel, W.: Thermische Turbomaschinen, Bd. I,II, Springer-Verlag, 1977, 1982

V **Thermal Turbomachines II (in English)** **Lecture / Practice (VÜ)**
2170553, SS 2019, 3 SWS, Language: English, Open in study portal

Learning Content
Basic concepts of thermal turbomachinery

Steam Turbines - Thermodynamic process analysis

Gas Turbines - Thermodynamic process analysis

Combined cycle and cogeneration processes

Overview of turbomachinery theory and kinematics

Energy transfer process within a turbine stage

Types of turbines (presented through examples)

1-D streamline analysis techniques

3-D flow fields and radial momentum equilibrium in turbines

Compressor stage analysis and future trends in turbomachinery

Workload
regular attendance: 31,50 h
self-study: 64,40 h

Literature
Lecture notes (available via Internet)

Bohl, W.: Strömungsmaschinen, Bd. I, II; Vogel Verlag, 1990, 1991

Sigloch, H.: Strömungsmaschinen, Carl Hanser Verlag, 1993

Traupel, W.: Thermische Turbomaschinen Bd. I, II, Springer-Verlag, 1977, 1982

T 3.329 Course: Thermal-Fluid-Dynamics [T-MACH-106372]

Responsible: Dr. Sebastian Ruck
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2189423	Thermal-Fluid-Dynamics	2 SWS	Lecture (V)	Ruck
Exams					
SS 2019	76-T-MACH-106372	Thermal-Fluid-Dynamics		Prüfung (PR)	Ruck, Stieglitz
WS 19/20	76-T-MACH-106372	Thermal-Fluid-Dynamics		Prüfung (PR)	Ruck, Stieglitz

Competence Certificate
oral exam of about 30 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Thermal-Fluid-Dynamics

2189423, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Main Issues

- Fundamentals of flows and heat transfer
- Dimensionless parameters of thermal fluid dynamics
- Statistic description and analytics of turbulent flows
- Thermal boundary layer equations
- Velocity and temperature laws in boundary layers
- Convective Heat transfer of external and internal flows
- Analogies (Prandtl-, von Kárman, Martinelli,...)
- Methods for enhancing heat transfer
- Strategies and methods for experimental and numerical investigation of thermal-hydraulics in R&D

Notes

Content

- Fundamentals of flows and heat transfer
- Dimensionless parameters of thermal fluid dynamics
- Laminar and turbulent thermal boundary layer equations
- Velocity and temperature laws in boundary layers
- Convective heat transfer of external and internal flows
- Heat transfer analogies (Prandtl-, von Kárman, Martinelli,...)
- Methods for enhancing heat transfer
- Strategies and methods for investigation of thermal-hydraulics in R&D

The lecture provides an overview of momentum and energy transport as occurring in power engineering components and heat exchangers. On the basis of the conservation equations and the fundamentals of thermal-hydraulics, dimensionless parameters for forced and free convection are evolved. Flows close to walls play a crucial role for the convective heat transfer and for heat exchanger components. Thus, with scaling rules the laminar and turbulent thermal boundary layer equations are introduced. In the following, velocity and temperature laws of the wall as a basis for analogies and models of computational tools are discussed and the influence of roughness and surface design are shown. Concepts of state-of-the-art turbulence modelling and their applicability for different conditions or different heat transfer fluids (e.g. liquid metals, gas, oil) are described. Analogies and correlations for internal and external forced convection are developed by means of approximation concepts. Design options to enhance the efficiency and effectiveness of heat exchangers are discussed.

The objectives of the lecture are the fundamentals of thermal-hydraulics for describing and modelling convective fluid flow as occurring in power engineering components. A major objective is the description of the convective heat transfer for external and internal flows. A key issue is the transfer of analytic models and empirical results into “state of the art” computational tools and their validation by advanced experimental methods. Within the scope of the course, the students learn (a) to develop differential equation for thermal-hydraulic problems and to describe the thermal flow field by means of dimensionless parameters, (b) to transfer a real problem to an experiment or computational model, (c) to develop analogies and correlations for heat transfer processes of forced convection, (d) to select adequate computational methods/models, (e) to evaluate and select experiments including measurement techniques with adequate instrumentation for thermal-hydraulic problems and (f) to know design option for an efficient and effective heat exchange.

Attendance time: 21 h

Preparation/follow-up time of lectures, exam preparation: 90h

Oral exam of about 30 min.

Learning Content

The lecture provides an overview of momentum and energy transport as occurring in power engineering components and heat exchangers. Conservation equations are discussed. Based on the fundamentals of thermal-hydraulics, dimensionless parameters for forced and free convection are evolved. The statistical concepts for describing turbulent flows and the corresponding transport equations are introduced. Analysis of thermal and turbulent measurement signals are discussed.

Flows close to walls play a crucial role for the convective heat transfer and for heat exchanger components. Thus, the thermal boundary layer equations are introduced for the laminar and turbulent case. Velocity and temperature laws of the wall as a basis for analogies and models of computational tools are discussed; turbulence modelling and scale-resolving methods and their applicability for different conditions or heat transfer fluids are described in the following. Analogies and correlations for internal and external forced convection are developed by means of approximation concepts. Furthermore, design options to enhance the efficiency of heat exchangers are discussed.

Solution strategies and best practical guidelines of the aforementioned methods are provided.

Workload

Attendance time: 21 h

Preparation/follow-up time of lectures, exam preparation: 90h

Literature

Literature are specified in the corresponding lectures. Teaching materials are provided online at **http://ilias.studium.kit.edu**. Hardcopy script for special topics during the lecture.

T 3.330 Course: Thin Film and Small-scale Mechanical Behavior [T-MACH-105554]

Responsible: Dr. Patric Gruber
Dr. Ruth Schwaiger
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2178123	Thin film and small-scale mechanical behavior	2 SWS	Lecture (V)	Weygand, Gruber
Exams					
SS 2019	76-T-MACH-105554	Thin Film and Small-scale Mechanical Behavior		Prüfung (PR)	Gruber, Weygand

Competence Certificate
oral exam 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in materials science, physics and mathematics

T 3.331 Course: Tires and Wheel Development for Passenger Cars [T-MACH-102207]

Responsible: Dr.-Ing. Günter Leister
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114845	Tires and Wheel Development for Passenger Cars	2 SWS	Lecture (V)	Leister
Exams					
SS 2019	76-T-MACH-102207	Tires and Wheel Development for Passenger Cars		Prüfung (PR)	Leister

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
none

Below you will find excerpts from events related to this course:

V Tires and Wheel Development for Passenger Cars — Lecture (V)
2114845, SS 2019, 2 SWS, Open in study portal

Learning Content

1. The role of the tires and wheels in a vehicle
2. Geometrie of Wheel and tire, Package, load capacity and endurance, Book of requirement
3. Mobility strategy, Minispare, runflat systems and repair kit.
4. Project management: Costs, weight, planning, documentation
5. Tire testing and tire properties
6. Wheel technology incuding Design and manifacturing methods, Wheeltesting
7. Tire presssure: Indirect and direct measuring systems
8. Tire testing subjective and objective

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
Manuscript to the lecture

T 3.332 Course: Tractors [T-MACH-105423]

Responsible: Simon Becker
Prof. Dr.-Ing. Marcus Geimer
Hon.-Prof. Dr. Martin Kremmer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2113080	Tractors	2 SWS		Kremmer, Becker
Exams					
WS 19/20	76-T-MACH-105423	Tractors		Prüfung (PR)	Geimer

Competence Certificate
The assessment consists of an written exam taking place in the recess period (90 min).

Prerequisites
none

Recommendation
Basic knowledge in mechanical engineering.

Annotation

Learning Outcomes

After completion of the course the Students know:

- important problems in agritechnological developments
- Customer requirements and their implementation in tractors
- Tractor technology in width and depth

Content

Tractors are one of the most underestimated vehicles in regard to performance und technics. Almost none vehicle is as multifunctional and fulfilled with high-tech as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies
During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical background, legal requirements, ways of development, agricultural organizations and the process of development itself.
In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

Literature

- K.T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960

Below you will find excerpts from events related to this course:

V **Tractors**
2113080, WS 19/20, 2 SWS, Language: German, **Open in study portal**

Learning Content

Tractors are one of the most underestimated vehicles in regard to performance und technics. Almost none vehicle is as multifunctional and fullfilled with high-tec as a tractor. Automatic guidance, special chassis suspension or special concepts of power trains are one of the topics where tractors are in leading position in technologies

During the lecture an overview about the design and construction and application area is given. A close look will be taken on the historical backround, legal requirements, ways of development, agricultural organizations and the proces of development itself.

In detail the following topics will be dealt with:

- agricultural organization / legal requirements
- history of tractors
- tractor engineering
- tractor mechanics
- chassis suspension
- combustion engine
- transmission
- interfaces
- hydraulics
- wheels and tyres
- cabin
- electrics and electronics

Workload

- regular attendance: 21 hours
- self-study: 92 hours

Literature

- K.T. Renius: Traktoren - Technik und ihre Anwendung; DLG Verlag (Frankfurt), 1985
- E. Schilling: Landmaschinen - Lehr- und Handbuch für den Landmaschinenbau; Schilling-Verlag (Köln), 1960

T 3.333 Course: Tribology [T-MACH-105531]

Responsible: Prof. Dr. Martin Dienwiebel
Prof. Dr.-Ing. Matthias Scherge

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	8	Each winter term	2

Events					
WS 19/20	2181114	Tribology	5 SWS	Lecture / Practice (VÜ)	Dienwiebel, Scherge
Exams					
SS 2019	76-T-MACH-105531	Tribology		Prüfung (PR)	Dienwiebel

Competence Certificate
oral examination (ca. 40 min)

no tools or reference materials

Prerequisites
admission to the exam only with successful completion of the exercises [T-MACH-109303]

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-109303 - Exercices - Tribology must have been passed.

Recommendation
preliminary knowlegde in mathematics, mechanics and materials science

Below you will find excerpts from events related to this course:

V Tribology
2181114, WS 19/20, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)

Notes

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

The student can

- describe the fundamental friction and wear mechanisms, which occur in tribologically stressed systems
- evaluate the friction and wear behavior of tribological systems
- explain the effects of lubricants and their most important additives
- identify suitable approaches to optimize tribological systems
- explain the most important experimental methods for the measurement of friction and wear, and is able to use them for the characterisation of tribo pairs
- choose suitable methods for the evaluation of roughness and topography from the nm-scale to the mm-scale and is able to interpret the determined values in respect to their effect on the tribological behavior
- describe the most important surface-analytical methods and their physical principles for the characterization of tribologically stressed sliding surfaces

preliminary knowlegde in mathematics, mechanics and materials science recommended

regular attendance: 45 hours
self-study: 195 hours

oral examination (ca. 40 min)

no tools or reference materials

admission to the exam only with successful completion of the exercises

Learning Content

- Chapter 1: Friction
  adhesion, geometrical and real area of contact, Friction experiments, friction powder, tribological stressing, evironmental influences, tribological age, contact models, Simulation of contacts, roughness.
- Chapter 2: Wear
  plastic deformation at the asperity level, dissipation modes, mechanical mixing, Dynamics of the third body, running-in, running- in dynamics, shear stress.
- Chapter 3: Lubrication
  base oils, Stribeck plot, lubrication regimes (HD, EHD, mixed lubrication), additives, oil characterization, solid lubrication.
- Chapter 4: Measurement Techniques
  friction measurement, tribometer, dissipated frictional power, conventional wear measurement, continuous wear measurement(RNT)
- Chapter 5: Roughness
  profilometry, surface roughness parameters, evaluation length and filters, bearing ratio curve, measurement error
- Chapter 6: Accompanying Analysis
  multi-scale topography measurement, chemical surface analysis, structural analysis, mechanical analysis

Exercises are used for complementing and deepening the contents of the lecture as well as for answering more extensive questions raised by the students.

Workload

regular attendance: 45 hours
self-study: 195 hours

Literature

1. Fleischer, G. ; Gröger, H. ; Thum: Verschleiß und Zuverlässigkeit. 1. Auflage. Berlin : VEB-Verlag Technik, 1980
2. Persson, B.J.N.: Sliding Friction, Springer Verlag Berlin, 1998
3. M. Dienwiebel, and M. Scherge, Nanotribology in automotive industry, In:Fundamentals of Friction and Wear on the Nanoscale; Editors: E. Meyer and E. Gnecco, Springer, Berlin, 2007.
4. Scherge, M., Shakhvorostov, D., Pöhlmann, K.: Fundamental wear mechanism of metals. Wear 255, 395–400 (2003)
5. Shakhvorostov, D., Pöhlmann, K., Scherge, M.: An energetic approach to friction, wear and temperature. Wear 257, 124–130 (2004)

T 3.334 Course: Turbine and Compressor Design [T-MACH-105365]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2169462	Turbine and compressor Design	2 SWS	Lecture (V)	Bauer
Exams					
SS 2019	76-T-MACH-105365	Turbine and Compressor Design		Prüfung (PR)	Schulz, Bauer

Competence Certificate
oral exam, duration: 20 min.

Prerequisites
Exams Thermal Turbomachinery I & II successfully passed.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105363 - Thermal Turbomachines I must have been passed.
2. The course T-MACH-105364 - Thermal Turbomachines II must have been passed.

Below you will find excerpts from events related to this course:

V Turbine and compressor Design

2169462, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Learning Content
The lecture is intended to expand the knowledge from Thermal Turbomachines I+II.

Thermal Turbomaschines, general overview

Design of a turbomachine: Criteria and development

Radial machines

Transonic compressors

Combustion chambers

Multi-spool installations

Workload
regular attendance: 21 h
self-study: 42 h

Literature
Münzberg, H.G.: Gasturbinen - Betriebsverhalten und Optimierung, Springer Verlag, 1977

Traupel, W.: Thermische Turbomaschinen, Bd. I-II, Springer Verlang, 1977, 1982

T 3.335 Course: Tutorial Mathematical Methods in Strength of Materials [T-MACH-106830]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Completed coursework	1	Each winter term	3

Competence Certificate
successfully solving the homework sheets. Details are announced in the first lecture.

Prerequisites
None

T 3.336 Course: Tutorial Mathematical Methods in Structural Mechanics [T-MACH-106831]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104847 - Major Field Fundamentals of Engineering

Type	Credits	Recurrence	Version
Completed coursework	1	Each summer term	2

Events					
SS 2019	2162281	Tutorial "Mathematical Methods in Micromechanics"	1 SWS	Practice (Ü)	N.N., Böhlke
Exams					
SS 2019	76-T-MACH-106831	Tutorial Mathematical Methods in Structural Mechanics		Prüfung (PR)	Böhlke

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

Prerequisites
none

T 3.337 Course: Two-Phase Flow and Heat Transfer [T-MACH-105406]

Responsible: Prof. Dr.-Ing. Thomas Schulenberg
Dr. Martin Wörner

Organisation: KIT Department of Chemical and Process Engineering
KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Version
Oral examination	4	1

Events					
WS 19/20	2169470	Two-Phase Flow and Heat Transfer	2 SWS	Lecture (V)	Wörner, Schulenberg

Competence Certificate
oral exam, duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Prerequisites
none

Below you will find excerpts from events related to this course:

V Two-Phase Flow and Heat Transfer

2169470, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Power Point presentations

Excel analyses

Notes
The students can describe two-phase flows with heat transfer as phenomena occuring in steam generators and condensers (e.g. in power stations or refrigerators). They can distinguish different flow regimes and transitions and apply two-phase flow models. The students are qualified to explain the characteristics of different flow examples (e.g. pressure drop of two phase flows, pool boiling, forced convective boiling, condensation) and can analysze two-phase flow instabilities.

- Examples for technical applications
- Definitions and averaging of two-phase flows
- Flow regimes and transitions
- Two-phase models
- Pressure drop of two phase flows
- Pool boiling
- Forced convective boiling
- Condensation
- Two-phase flow instabilities

Learning Content

- Examples for technical applications
- Definitions and averaging of two-phase flows
- Flow regimes and transitions
- Two-phase models
- Pressure drop of two phase flows
- Pool boiling
- Forced convective boiling
- Condensation
- Two-phase flow instabilities

Annotation
Recommendations: Basics of fluid mechanics and thermodynamics are a mandatory requirement.

Workload
regular attendance: 21 h
self-study: 99 h

Literature
lecture notes

T 3.338 Course: Vacuum and Tritium Technology in Nuclear Fusion [T-MACH-108784]

Responsible: Dr. Beate Bornschein
Dr. Christian Day

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2190499	Vacuum and Tritium Technology in Nuclear Fusion	2 SWS		Day, Größle
Exams					
SS 2019	76-T-MACH-108784	Vacuum and Tritium Technology in Nuclear Fusion		Prüfung (PR)	Day, Bornschein

Competence Certificate
oral examination, 20 Minutes, any time in the year

Prerequisites
none

Recommendation
Knowledge in ´Fusion Technology A´

Below you will find excerpts from events related to this course:

V Vacuum and Tritium Technology in Nuclear Fusion
2190499, SS 2019, 2 SWS, Language: German/English, Open in study portal

Notes
Introduction

Tritium Handling

Tritium Plant Technologies

Tritium and Breeding

Fundamentals of Vacuum Science and Technology

Fusion Vacuum systems

Matter Injection into the Plasma Chamber

Fuel Cycle of ITER and DEMO

The students have acquired the necessary understanding in order to design and size facilities for tritium operation. They understand the process steps in the tritium plant of a fusion reactor for tritium removal and tritium recovery from tritiated exhaust gas. Furthermore, the students have understood the fundamentals of vacuum physics and are able to design and choose vacuum pumps properly.

recommended is Knowledge in "Fusion Technology A"

oral exam of about 20 min

Learning Content
Introduction

Tritium Handling

Tritium Plant Technologies

Tritium and Breeding

Fundamentals of Vacuum Science and Technology

Fusion Vacuum systems

Matter Injection into the Plasma Chamber

Fuel Cycle of ITER and DEMO

T 3.339 Course: Vehicle Comfort and Acoustics I [T-MACH-105154]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering
M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
SS 2019	2114856	Vehicle Ride Comfort & Acoustics I	2 SWS	Lecture (V)	Gauterin
WS 19/20	2113806	Vehicle Comfort and Acoustics I	2 SWS	Lecture (V)	Gauterin
Exams					
SS 2019	76-T-MACH-105154	Vehicle Comfort and Acoustics I		Prüfung (PR)	Gauterin
SS 2019	76T-Mach-105154_1	Vehicle Comfort and Acoustics I		Prüfung (PR)	Gauterin

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
Can not be combined with lecture T-MACH-102206

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102206 - Vehicle Ride Comfort & Acoustics I must not have been started.

Below you will find excerpts from events related to this course:

V Vehicle Ride Comfort & Acoustics I

2114856, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
In English language.

Learning Content
1. Perception of noise and vibrations

3. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chasis for the acoustic and mechanical driving comfort:
phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Michael Möser, Technische Akustik, Springer, Berlin, 2005

2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

3. Manfred Mitschke, Dynamik der Kraftfahrzeuge, Band B: Schwingungen, Springer, Berlin, 1997

The script will be supplied in the lectures

V **Vehicle Comfort and Acoustics I** **Lecture (V)**
2113806, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
1. Perception of noise and vibrations

3. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chasis for the acoustic and mechanical driving comfort:
phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
1. Michael Möser, Technische Akustik, Springer, Berlin, 2005

2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

3. Manfred Mitschke, Dynamik der Kraftfahrzeuge, Band B: Schwingungen, Springer, Berlin, 1997

The script will be supplied in the lectures

T 3.340 Course: Vehicle Comfort and Acoustics II [T-MACH-105155]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering
M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	2114825	Vehicle Comfort and Acoustics II	2 SWS	Lecture (V)	Gauterin
SS 2019	2114857	Vehicle Ride Comfort & Acoustics II	2 SWS	Lecture (V)	Gauterin
Exams					
SS 2019	76-T-MACH-105155	Vehicle Comfort and Acoustics II		Prüfung (PR)	Gauterin

Competence Certificate
Oral Examination

Duration: 30 up to 40 minutes

Auxiliary means: none

Prerequisites
Can not be combined with lecture T-MACH-102205

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102205 - Vehicle Ride Comfort & Acoustics II must not have been started.

Below you will find excerpts from events related to this course:

V Vehicle Comfort and Acoustics II
Lecture (V)
2114825, SS 2019, 2 SWS, Language: German, Open in study portal

Learning Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
- phenomena
- influencing parameters
- types of construction
- optimization of components and systems
- conflicts of goals
- methods of development

3. Noise emission of motor vehicles
- noise stress
- sound sources and influencing parameters
- legal restraints
- optimization of components and systems
- conflict of goals
- methods of development

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
The script will be supplied in the lectures.

V Vehicle Ride Comfort & Acoustics II

2114857, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
The lecture starts in June 2016. Exact date of beginning: see homepage of institute.

In English language.

Learning Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
- phenomena
- influencing parameters
- types of construction
- optimization of components and systems
- conflicts of goals
- methods of development

3. Noise emission of motor vehicles
- noise stress
- sound sources and influencing parameters
- legal restraints
- optimization of components and systems
- conflict of goals
- methods of development

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
The script will be supplied in the lectures.

T 3.341 Course: Vehicle Ergonomics [T-MACH-108374]

Responsible: Dr.-Ing. Tobias Heine
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	1

Events					
SS 2019	2110050	Vehicle Ergonomics	2 SWS	Lecture (V)	Heine
Exams					
SS 2019	76-T-MACH-108374	Vehicle Ergonomics		Prüfung (PR)	Deml

Competence Certificate
written exam, 60 minutes

Prerequisites
none

Below you will find excerpts from events related to this course:

V Vehicle Ergonomics

2110050, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
- Basics of physical-body related ergonomics
- Basics of cognitive ergonomics
- Theories of driver behaviour
- interface design
- usability testing

Learning objective:

An ergonomic vehicle is best adapted to the requirements, needs and characteristics of its users, thus enabling effective, efficient and satisfactory interaction. After attending the lecture, students will be able to analyse and evaluate the ergonomic quality of various vehicle concepts and derive design recommendations. They can consider aspects of both physical-body and cognitive ergonomics. The students are familiar with basic ergonomic methods, theories and concepts as well as with theories of human information processing, especially driver behaviour. They are able to discuss this knowledge critically and to apply it flexibly within the framework of the user-oriented design process.

Translated with www.DeepL.com/Translator

T 3.342 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-105237]

Responsible: Prof. Dr.-Ing. Frank Henning
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Events					
WS 19/20	2113102	Vehicle Lightweight design – Strategies, Concepts, Materials	2 SWS	Lecture (V)	Henning
Exams					
SS 2019	76-T-MACH-105237	Vehicle Lightweight Design - Strategies, Concepts, Materials		Prüfung (PR)	Henning

Competence Certificate
Written exam, 90 minutes

Prerequisites
none

Recommendation
none

Below you will find excerpts from events related to this course:

V Vehicle Lightweight design – Strategies, Concepts, Materials

Lecture (V)

2113102, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
strategies in lightweight design
shape optimization, light weight materials, multi-materials and concepts for lightweight design

construction methods
differential, integral, sandwich, modular, bionic

body construction
shell, space frame, monocoque

metalic materials
steal, aluminium, magnesium, titan

Workload
lectures: 21h, preparation of examination: 79h

T 3.343 Course: Vehicle Mechatronics I [T-MACH-105156]

Responsible: Prof. Dr.-Ing. Dieter Ammon
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104849 - Major Field Automotive Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	1

Competence Certificate
Written examination

Duration: 90 minutes

Auxiliary means: none

Prerequisites
none

T 3.344 Course: Vehicle Ride Comfort & Acoustics I [T-MACH-102206]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	1

Events					
SS 2019	2114856	Vehicle Ride Comfort & Acoustics I	2 SWS	Lecture (V)	Gauterin
Exams					
SS 2019	76-T-MACH-102206	Vehicle Ride Comfort & Acoustics I		Prüfung (PR)	Gauterin

Competence Certificate
Oral examination

Prerequisites
Can not be combined with lecture Fahrzeugkomfort und -akustik I T-MACH-105154

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105154 - Vehicle Comfort and Acoustics I must not have been started.

Below you will find excerpts from events related to this course:

V Vehicle Ride Comfort & Acoustics I — Lecture (V)
2114856, SS 2019, 2 SWS, Language: English, Open in study portal

Notes
In English language.

Learning Content
1. Perception of noise and vibrations

3. Fundamentals of acoustics and vibrations

3. Tools and methods for measurement, computing, simulation and analysis of noise and vibrations

4. The relevance of tire and chasis for the acoustic and mechanical driving comfort:
phenomena, influencing parameters, types of construction, optimization of components and systems, conflict of goals, methods of development

An excursion will give insights in the development practice of a car manufacturer or a system supplier.

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature

1. Michael Möser, Technische Akustik, Springer, Berlin, 2005

2. Russel C. Hibbeler, Technische Mechanik 3, Dynamik, Pearson Studium, München, 2006

3. Manfred Mitschke, Dynamik der Kraftfahrzeuge, Band B: Schwingungen, Springer, Berlin, 1997

The script will be supplied in the lectures

T 3.345 Course: Vehicle Ride Comfort & Acoustics II [T-MACH-102205]

Responsible: Prof. Dr. Frank Gauterin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	3	Each summer term	1

Events					
SS 2019	2114857	Vehicle Ride Comfort & Acoustics II	2 SWS	Lecture (V)	Gauterin
Exams					
SS 2019	76-T-MACH-102205	Vehicle Ride Comfort & Acoustics II		Prüfung (PR)	Gauterin

Competence Certificate
Oral examination

Prerequisites
Can not be combined with lecture Fahrzeugkomfort und -akustik II T-MACH-105155

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-105155 - Vehicle Comfort and Acoustics II must not have been started.

Below you will find excerpts from events related to this course:

V Vehicle Ride Comfort & Acoustics II
2114857, SS 2019, 2 SWS, Language: English, Open in study portal

Lecture (V)

Notes
The lecture starts in June 2016. Exact date of beginning: see homepage of institute.

In English language.

Learning Content
1. Summary of the fundamentals of acoustics and vibrations

2. The relevance of road surface, wheel imperfections, springs, dampers, brakes, bearings and bushings, suspensions, engines and drive train for the acoustic and mechanical driving comfort:
- phenomena
- influencing parameters
- types of construction
- optimization of components and systems
- conflicts of goals
- methods of development

3. Noise emission of motor vehicles
- noise stress
- sound sources and influencing parameters
- legal restraints
- optimization of components and systems
- conflict of goals
- methods of development

Workload
regular attendance: 22,5 hours
self-study: 97,5 hours

Literature
The script will be supplied in the lectures.

T 3.346 Course: Vibration Theory [T-MACH-105290]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Prof. Dr.-Ing. Wolfgang Seemann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	5	Each winter term	2

Events					
WS 19/20	2161212	Vibration Theory	2 SWS	Lecture (V)	Fidlin, Römer
WS 19/20	2161213	Übungen zu Technische Schwingungslehre	2 SWS	Practice (Ü)	Fidlin, Römer, Burgert

Competence Certificate
written exam, 180 min.

Prerequisites
none

Below you will find excerpts from events related to this course:

V Vibration Theory

Lecture (V)

2161212, WS 19/20, 2 SWS, Language: German, Open in study portal

Learning Content
Concept of vibration, superposition of vibration with equal and with different frequencies, complex frequency response.

Vibration of systems with one dof: Free undamped and damped vibration, forced vibration for harmonic, periodic and arbitrary excitation. Excitation of undamped vibration in resonance.

Systems with many degrees of freedom: Eigenvalue problem for undamped vibration, orthogonality of eigenvectors, modal decoupling, approximation methods, eigenvalue problem for damped vibration. Forced vibration for harmonic excitation, modal decomposition for arbitrary forced vibration, vibration absorber.

Vibration of systems with distributed parameters: Partial differential equations as equations of motion, wave propagation, d'Alembert's solution, Ansatz for separation of time and space, eigenvalue problem, infinite number of eigenvalues and eigenfunctions.

Introduction to rotor dynamics: Laval rotor in rigid and elastic bearings, inner damping, Laval rotor in anisotropic bearings, synchronous and asynchronous whirl, rotors with asymmetric shaft.

Workload
time of attendance: 22,5 h; self-study: 128 h

Literature
Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978

Hagedorn, Otterbein: Technische Schwingungslehre, Bd 1 and Bd 2, Berlin, 1987

Wittenburg: Schwingungslehre, Springer-Verlag, Berlin, 1995

T 3.347 Course: Virtual Engineering (Specific Topics) [T-MACH-105381]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104878 - Specification in Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each summer term	1

Events					
SS 2019	3122031	Virtual Engineering (Specific Topics)	2 SWS	Lecture (V)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-105381	Virtual Engineering (Specific Topics)		Prüfung (PR)	Ovtcharova

Competence Certificate
oral exam, 20 min.

Prerequisites
none

T 3.348 Course: Virtual Engineering I [T-MACH-102123]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Events					
WS 19/20	2121352	Virtual Engineering I	2 SWS	Lecture (V)	Ovtcharova
WS 19/20	2121353	Exercises Virtual Engineering I	2 SWS	Practice (Ü)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102123	Virtual Engineering I		Prüfung (PR)	Ovtcharova

Competence Certificate
Writen examination 90 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Virtual Engineering I
2121352, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

Lecture notes

Learning Content
The lecture communicates IT aspects required for understanding virtual product development processes. For this purpose, the focus is set on systems used in industry supporting the process chain of Virtual Engineering:

- Product Lifecycle Management is an approach for managing product related data across the entire lifecycle of the product, beginning with the concept phase until disassembling and recycling.
- CAx-systems for virtual product development allow modeling digital products regarding design, construction, manufacturing and maintenance.
- Validation systems enable the analysis of products regarding statics, dynamics, safety and manufacturing feasibility.

The objective of the lecture is to clarify the relationship between construction and validation operations by applying virtual prototypes and VR/AR/MR visualization techniques in combination with PDM/PLM-systems. This is taught by introducing each particular system in applied exercises.

V Exercises Virtual Engineering I
2121353, WS 19/20, 2 SWS, Language: German/English, Open in study portal

Practice (Ü)

Learning Content
In this module, the practical application of different CAx software systems is exemplarily conducted in small groups, the main focus being the CAD systems CATIA V5 (DASSAULT SYSTEMES) and NX 5 (Siemens PLM Software).

Workload
Regular attendance: 31,5 hours, self-study: 10,5 hours

Literature
Exercise notes

T 3.349 Course: Virtual Engineering II [T-MACH-102124]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104851 - Major Field Product Development and Construction
M-MACH-104878 - Specification in Mechanical Engineering
M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each summer term	2

Events					
SS 2019	2122378	Virtual Engineering II	2 SWS	Lecture (V)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102124	Virtual Engineering II		Prüfung (PR)	Ovtcharova

Competence Certificate
Writen examination 90 min.

Prerequisites
None

Below you will find excerpts from events related to this course:

V Virtual Engineering II
2122378, SS 2019, 2 SWS, Language: German/English, Open in study portal

Lecture (V)

Description
Media:

Lecture notes

Learning Content
The lecture presents the IT aspects required for understanding virtual product development processes:

- Corresponding models can be visualized in Virtual Reality Systems, from individual parts to complete assembles.
- Virtual Prototypes combine CAD-data and information about properties of components and assemblies for immersive visualization, functionality tests and functional validation in VR/AR/MR environments.
- Integrated Virtual Product Development explains product development processes from the point of view of Virtual Engineering.

The objective of this lecture is to clarify the relationship between construction and validation operations by using virtual prototypes and VR/AR/MR visualization techniques in combination with PDM/PLM-systems. This will be achieved by introducing each particular IT-system with practical-oriented exercises.

T 3.350 Course: Virtual Reality Practical Course [T-MACH-102149]

Responsible: Prof. Dr.-Ing. Jivka Ovtcharova
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104850 - Major Field Mechatronics and Microsystem Technology

Type	Credits	Recurrence	Version
Examination of another type	4	Each term	2

Events					
WS 19/20	2123375	Virtual Reality Practical Course	3 SWS	Project (PRO)	Ovtcharova, Mitarbeiter
Exams					
SS 2019	76-T-MACH-102149	Virtual Reality Practical Course		Prüfung (PR)	Ovtcharova

Competence Certificate
Assessment of another type (graded)

Prerequisites
None

Annotation
Number of participants is limited

Below you will find excerpts from events related to this course:

V Virtual Reality Practical Course

Project (PRO)

2123375, WS 19/20, 3 SWS, Language: German/English, Open in study portal

Learning Content
The lab course consists of:

1. Introduction and basics in virtual reality (hardware, software, application)
2. Introduction in 3DVIA Virtools tool kit as an application development system
3. IMplermentation and practice by developing a driving simulator in small groups.

T 3.351 Course: Warehousing and Distribution Systems [T-MACH-105174]

Responsible: Prof. Dr.-Ing. Kai Furmans
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104852 - Major Field Production Technology

Type	Credits	Recurrence	Version
Written examination	3	Each summer term	2

Events					
SS 2019	2118097	Warehousing and distribution systems	2 SWS	Lecture (V)	Furmans
Exams					
SS 2019	76-T-MACH-105174	Warehousing and Distribution Systems		Prüfung (PR)	Furmans

Competence Certificate
The assessment consists of a 60 minutes written examination (according to §4(2), 1 of the examination regulation).

Prerequisites
none

Below you will find excerpts from events related to this course:

V Warehousing and distribution systems
2118097, SS 2019, 2 SWS, Language: German, Open in study portal

Lecture (V)

Description
Media:

presentations, black board

Learning Content

- Introduction
- Yard management
- Receiving
- Storage and picking
- Workshop on cycle times
- Consoldiation and packing
- Shipping
- Added Value
- Overhead
- Case Study: DCRM
- Planning of warehouses
- Case study: Planning of warehouses
- Distribution networks
- Lean Warehousing

Annotation
none

Workload
regular attendance: 21 hours
self-study: 99 hours

Literature

ARNOLD, Dieter, FURMANS, Kai (2005)
Materialfluss in Logistiksystemen, 5. Auflage, Berlin: Springer-Verlag

ARNOLD, Dieter (Hrsg.) et al. (2008)
Handbuch Logistik, 3. Auflage, Berlin: Springer-Verlag

BARTHOLDI III, John J., HACKMAN, Steven T. (2008)
Warehouse Science

GUDEHUS, Timm (2005)
Logistik, 3. Auflage, Berlin: Springer-Verlag

FRAZELLE, Edward (2002)
World-class warehousing and material handling, McGraw-Hill

MARTIN, Heinrich (1999)
Praxiswissen Materialflußplanung: Transport, Hanshaben, Lagern, Kommissionieren, Braunschweig, Wiesbaden: Vieweg

WISSER, Jens (2009)
Der Prozess Lagern und Kommissionieren im Rahmen des Distribution Center Reference Model (DCRM); Karlsruhe : Universitätsverlag

A comprehensive overview of scientific papers can be found at:

ROODBERGEN, Kees Jan (2007)
Warehouse Literature

T 3.352 Course: Wave Propagation [T-MACH-105443]

Responsible: Prof. Dr.-Ing. Wolfgang Seemann
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104853 - Major Field Theoretical Foundations of Mechanical Engineering

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	2

Events					
WS 19/20	2161219	Wave Propagation	2 SWS	Lecture (V)	Seemann

Competence Certificate
oral exam, 30 min.

T 3.353 Course: Welding Technology [T-MACH-105170]

Responsible: Dr. Majid Farajian
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Oral examination	4	Each winter term	1

Events					
WS 19/20	2173571	Welding Technology	2 SWS	Lecture (V)	Farajian

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basics of material science (iron- and non-iron alloys), materials, processes and production, design.

All the relevant books of the German Welding Institute (DVS: Deutscher Verband für Schweißen und verwandte Verfahren) in the field of welding and joining is recommended.

Below you will find excerpts from events related to this course:

V Welding Technology

2173571, WS 19/20, 2 SWS, Language: German, Open in study portal

Lecture (V)

Notes
definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

learning objectives:

The students have knowledge and understanding of the most important welding processes and its industrial application.

They are able to recognize, understand and handle problems occurring during the application of different welding processes relating to design, material and production.

They know the classification and the importance of welding technology within the scope of connecting processes (advantages/disadvantages, alternatives).

The students will understand the influence of weld quality on the performance and behavior of welded joints under static and cyclic load.

How the fatigue life of welded joints could be increased, will be part of the course.

requirements:
basics of material science (iron- and non-iron alloys), of electrical engineering, of production processes.

workload:

The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

Learning Content
definition, application and differentiation: welding,

welding processes, alternative connecting technologies.

history of welding technology

sources of energy for welding processes

Survey: Fusion welding,

pressure welding.

weld seam preparation/design

welding positions

weldability

gas welding, thermal cutting, manual metal-arc welding

submerged arc welding

gas-shielded metal-arc welding, friction stir welding, laser beam and electron beam welding, other fusion and pressure welding processes

static and cyclic behavior of welded joints,

fatigue life improvement techniques

Workload
The workload for the lecture Welding Technology is 120 h per semester and consists of the presence during the lecture (18 h) as well as preparation and rework time at home (102 h).

Literature

Für ergänzende, vertiefende Studien gibt das

Handbuch der Schweißtechnik von J. Ruge, Springer Verlag Berlin, mit seinen vier Bänden

Band I: Werkstoffe

Band II: Verfahren und Fertigung

Band III: Konstruktive Gestaltung der Bauteile

Band IV: Berechnung der Verbindungen

einen umfassenden Überblick. Der Stoff der Vorlesung Schweißtechnik findet sich in den Bänden I und II. Einen kompakten Einblick in die Lichtbogenschweißverfahren bietet das Bändchen

Nies: Lichtbogenschweißtechnik, Bibliothek der Technik Band 57, Verlag moderne Industrie AG und Co., Landsberg / Lech

Im Übrigen sei auf die zahlreichen Fachbücher des DVS Verlages, Düsseldorf, zu allen Einzelgebieten der Fügetechnik verwiesen.

3.354 Course: Windpower [T-MACH-105234]

Responsible: Dr. Norbert Lewald
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-104848 - Major Field Energy and Environmental Engineering

Type	Credits	Recurrence	Version
Written examination	4	Each winter term	2

Competence Certificate
written exam, 120 minutes

Prerequisites
none

T 3.355 Course: Working Methods in Materials Science and Technology [T-MACH-100288]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-104854 - Major Field Materials and Structures for High Performance Systems

Type	Credits	Recurrence	Version
Completed coursework (practical)	2	Each term	1

T 3.356 Course: Workshop on computer-based flow measurement techniques [T-MACH-106707]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-105134 - Elective Module Mechanical Engineering

Type	Credits	Recurrence	Version
Completed coursework	4	Each term	1

Events					
SS 2019	2171488	Workshop on computer-based flow measurement techniques	3 SWS	Practical course (P)	Bauer, Mitarbeiter
WS 19/20	2171488	Workshop on computer-based flow measurement techniques	3 SWS	Practical course (P)	Bauer, Mitarbeiter
Exams					
SS 2019	76-T-MACH-106707	Workshop on computer-based flow measurement techniques		Prüfung (PR)	Bauer

Competence Certificate
Group colloquia for each topic

Duration: approximately 10 minutes

no tools or reference materials may be used

Prerequisites
none

Below you will find excerpts from events related to this course:

V Workshop on computer-based flow measurement techniques

2171488, SS 2019, 3 SWS, Language: German, Open in study portal

Practical course (P)

Learning Content
The laboratory course offers an introduction into the acquisition of basic test data in fluid mechanics applications as well as a basic hands-on training for the application of modern PC based data acquisition methods. The combination of lectures about measurement techniques, sensors, signal converters, I/O systems, bus systems, data acquisition, handling and control routines and tutorials for typical fluid mechanics applications allows the participant to get a comprehensive insight and a sound knowledge in this field. The graphical programming environment LabVIEW from National Instruments is used in this course as it is one of the standard software tools for data acquisition worldwide.

Basic design of measurements systems

- Logging devices and sensors
- Analog to digital conversion
- Program design and programming methods using LabView
- Data handling
- Bus systems
- Design of a computer aided data acquisition system for pressure, temperature and derived parameters
- frequency analysis

Annotation
Registration during the lecture period via the website.

Workload
regular attendance: 52,5
self-study: 67,5

Literature
Germer, H.; Wefers, N.: Meßelektronik, Bd. 1, 1985

LabView User Manual

Hoffmann, Jörg: Taschenbuch der Messtechnik, 6., aktualisierte. Aufl. , 2011

V **Workshop on computer-based flow measurement techniques** **Practical course (P)**
2171488, WS 19/20, 3 SWS, Language: German, Open in study portal

Learning Content
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