Karlsruher Institut für Technologie

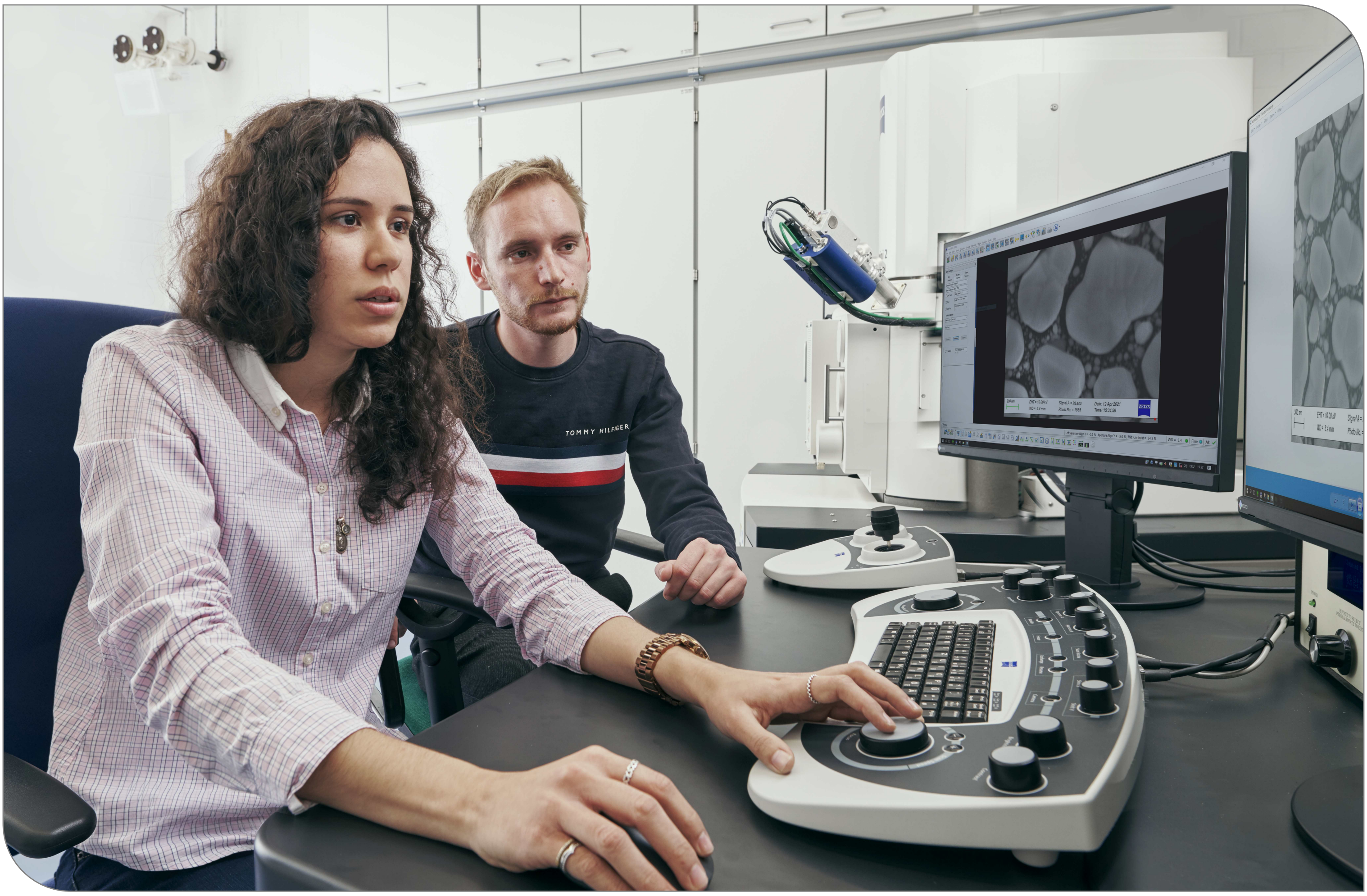
Module Handbook
Materials Science and Engineering Master 2017 (Master of Science (M.Sc.))

SPO 2017

Summer term 2025

Date: 25/02/2025

KIT DEPARTMENT OF MECHANICAL ENGINEERING



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Qualification objectives

The graduates of the master’s program of Materials Science and Engineering of the KIT are able to participate independently in value-added processes from material development and production to further processing or product development and to contribute in science thanks to their research-based studies. They are mainly qualified for responsible jobs in industries, technical services and science and acquire the qualification for doctoral studies.

The graduates acquire a broad and deeper knowledge in the principles of natural and engineering science. A mandatory range that includes thermodynamics and kinetics, electronic and mechanical properties of materials, modelling and simulation as well as materials processing, ensures this. Thus, they are able to deal with the current state of research and to develop methods. They can develop, evaluate and interpret comprehensive and interdisciplinary simulation studies. They are able to develop, select and evaluate materials in value-added processes as well as suitable further processing techniques. To optimize their own approaches, the graduates have learned to overthink the methods they use and the actions they undertake and adapt them to varying boundary conditions.

In the area of specialization, consisting of two focal points, graduates acquire comprehensive and detailed knowledge in their chosen areas of materials science and engineering. In this context, the research-oriented competence is developed in specialized trainings in the KIT research laboratories within the scope of their selected specializations. Graduates are thus qualified to play an important role in complex research and development projects and to participate competently in the innovation process, and are professionally prepared for later leadership functions. In other elective subjects, including non-technical ones, students acquire further competences, particularly in social and economics subjects of their own choice. Amongst others, they are able to make well-considered decisions taking into account social, economic and ethical constraints. They have tested and consolidated their skills and knowledge in a company environment during an industrial training.

Graduates of the master’s program of Materials Science and Engineering of the KIT possess broad and deep knowledge. This solid basis enables them to grasp and assess even complex interrelationships with regard to the use and selection of materials in complex systems and to analyze them. In addition, they are able to understand the value chain from the material to its use in the system, taking into account technical, social, economic and ethical constraints. They can methodically develop, reflect on, evaluate and independently and sustainably design. They deal constructively with their own and others' views and represent their work results in a generally understandable form.

The graduates of the master’s program are qualified to identify tasks on their own, to collect information necessary to solve a problem, choose methods and apply skills regarding production, further processing, selection and deployment of materials, and thus contribute to value-added processes.

Studies Plan of the KIT Department of Mechanical Engineering for the Master's Program of Materials Science and Engineering (MatWerk) Studies and Examination Regulations Version of 2017 (PO-Version 2017)

The present English translation has no legally binding effect. It is provided for your information only.

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History of Revisions (from 01.10.2020)

Date	Revision made
15.03.2021	Update of courses in the focal courses
24.09.2021	Update of courses in the focal courses
30.03.2022	Update of courses and examinations in the module Technical Specialization and in the focal courses
02.09.2022	Update of courses in the module Technical Specialization and in the focal courses
26.01.2023	Update of courses in the focal courses
28.06.2023	Update of courses in the focal courses
12.03.2024	Update of courses in the focal courses
03.09.2024	Update of courses in the module Technical Specialization and in the focal courses
24.02.2025	Update of courses in the module Technical Specialization and in the focal courses

0. List of Abbreviations

KIT Departments:	mach	KIT-Fakultät für Maschinenbau (KIT Department of Mechanical Engineering)
	inf	KIT-Fakultät für Informatik (KIT Department of Informatics)
	etit	KIT-Fakultät für Elektrotechnik und Informationstechnik (KIT Department of Electrical Engineering and Information Technology)
	chem	KIT-Fakultät für Chemie und Biowissenschaften (KIT Department of Chemistry and Biosciences)
	ciw	KIT-Fakultät für Chemieingenieurwesen und Verfahrenstechnik (KIT Department of Chemical and Process Engineering)
	phys	KIT-Fakultät für Physik (KIT Department of Physics)
	wiwi	KIT-Fakultät für Wirtschaftswissenschaften (KIT Department of Economics and Management)
Semester:	WS	Winter semester
	SS	Summer semester
	ww	optional (offered in both the summer and winter semesters)
Language:	D	Deutsch (German)
	E	Englisch (English)
Achievements:	V	Vorlesung (lecture)
	Ü	Übung (exercise)
	P	Praktikum (internship)
	LP	Leistungspunkte (credits)
	mPr	mündliche Prüfung (oral examination)
	sPr	schriftliche Prüfung (written examination)
	PA	Prüfungsleistung anderer Art (examination of another type)
	SL	Studienleistung (coursework)
	Gew	Gewichtung einer Prüfungsleistung im Modul bzw. in der Gesamtnote des Moduls (weighting of an examination result in the module or in the total grade of the module)
Others:	B.Sc.	Studiengang Bachelor of Science (Bachelor of Science program)
	M.Sc.	Studiengang Master of Science (Master of Science program)
	MatWerk	Materialwissenschaft und Werkstofftechnik (Materials Science and Engineering)
	SPO	Studien- und Prüfungsordnung (studies and examination regulations)
	SWS	Semesterwochenstunden (weekly teaching hours)
	w	wählbar (selectable)
	p	verpflichtend (mandatory)

1. Studies Plans, Modules, and Examinations

The credits (Leistungspunkte, LP) are given according to the “European Credit Transfer and Accumulation System“ (ECTS).

1.1. Examinations

Every semester, at least one examination date must be offered for every examination. Examinations dates and times as well as dates on which students have to register for the examinations at the latest are specified by the examination committee. As a rule, registration for the examination takes place at least one week before the examination. Registration and examination dates are announced on the notice board in due time. Dates of written examinations are announced at the beginning of the lecture period, if possible.

The examiner decides on aids that may be used during an examination. The list of permitted aids must be announced together with the examination date.

The following rules apply to controls of success in the focus modules: In principle, examinations have to be carried out orally. If the examination expenditure is unacceptably high, an oral examination may be replaced by a written one. Oral examinations in focus subjects or partial modules of focuses must have a duration of 5 minutes per credit. If an oral examination is assigned more than 12 credits, the examination duration shall be 60 minutes.

Required coursework can be repeated several times.

1.2. Modules in the Master’s Program

Studies within the master’s program may be started in the winter or in the summer semester. Due to the options available (focuses, interdisciplinary complementary courses, transferable skills), no generally valid studies plan can be given. The options regarding the focuses are listed below. When calculating the total module grade, graded controls of success are considered with the weights indicated (Gew).

The subject of “Überfachliche Qualifikationen” (transferable skills) described in Articles 15 a and 19, par. 2 of the Studies and Examination Regulations covers of the “Schlüsselqualifikationen” (key competences) module, within which courses offered by the KIT House of Competence (HoC), KIT-Sprachenzentrum (SPZ, Language Center), and Studium Generale at the Forum Wissenschaft und Gesellschaft (FORUM, formerly ZAK) and controls of success in the total amount of 4 credits can be selected freely. At the student’s request, the examination committee can permit other, freely selectable controls of success in the module “Schlüsselqualifikationen” (key competences).

The following modules are part of the master's program:

Modules	Partial Achievement	Coordinator	Credits	Controls of Success	Gew
1 Thermodynamik (Thermodynamics)	Thermodynamische Grundlagen / Heterogene Gleichgewichte Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	Seifert	6	SL, mPr	6
2 Kinetik (Kinetics)	Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion Solid-state Reactions and Kinetics of Phase Transformations, Corrosion	Seifert	6	SL, mPr	6
3 Simulation (Simulation)	Angewandte Werkstoffsimulation Applied Materials Simulation	Gumbsch	6	SL, mPr	6
4 Eigenschaften (Properties)	Gefüge-Eigenschafts-Beziehungen Microstructure-Property Relationships	Kirchlechner	6	SL, mPr	6
5 Werkstoffanalytik (Materials Characterization)	Werkstoffanalytik Materials Characterization	Pundt	6	SL, mPr	6
6 Schwerpunkt I (Focal Course I)	Cf. section 3		16	mPr	16
7 Schwerpunkt II (Focus Course II)	Cf. section 3		16	mPr	16
8 Technische Vertiefung (Technical Specialisation)	See 1.4		12	m/sPr	12
9 Schlüsselqualifikationen (Key competences)	HoC/SPZ/FORUM courses		4	SL*	0

In modules 1-5, all partial achievements are offered in both English and German.

In modules 6-9, students may choose from English or German partial achievements up to the total amount of credits of the module.

* The subject of "Überfachliche Qualifikationen" (Interdisciplinary Qualifications) and the module of "Schlüsselqualifikationen" (Key competences) are not graded. Graded controls of success in the Schlüsselqualifikationen (Key competences) are listed in the transcript of records, but not considered when calculating the total grade.

In addition, an internship of 9 weeks' duration has to be passed (12 credits).

After the module examinations, a master's thesis of 6 months' duration (30 credits) has to be written and presented.

Studies plan of the KIT Department of Mechanical Engineering for the Master's Program of Materials Science and Engineering SPO2017, Decision by the KIT Department Council of November 27, 2019 with editorial revisions, valid from 01.04.2022

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1.3. Studies Plan of the Master's Program "M.Sc."

Plan of studies in German throughout:

Semester	WS 1	SS 2	WS 3	SS 4	Total
Subject	32 LP	30 LP	28 LP	30 LP	120 LP
Materialwiss. Vertiefung	Thermodynamische Grundlagen / Heterogene Gleichgewichte 6 LP, mPr Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion 6 LP, mPr	Angewandte Werkstoffsimulation 6 LP, mPr Gefüge-Eigenschafts-Beziehungen 6 LP, mPr Werkstoffanalytik 6 LP, mPr		Masterarbeit 30 LP	30 LP
Schwerpunkt I *	Siehe 3.2 8 LP, 2 mPr	Siehe 3.2 8 LP, 2 mPr			16 LP
Schwerpunkt II *			Siehe 3.2 16 LP, 3 mPr		16 LP
Interdisziplinäre Ergänzung		Siehe 1.4 4 LP, m/sPr	Siehe 1.4 8 LP, m/sPr		12 LP
Überfachliche Qualifikationen			HoC/SPZ/FORUM-Veranst. 4 LP, SL		4 LP
	Berufspraktikum 12 LP				12 LP

* Selection of two from four possible focal courses according to Section 3. The precise amount of credits per semester depends on the courses chosen.

Plan of studies in English throughout:

Semester Subject	WS 1 32 credits	SS 2 30 credits	WS 3 28 credits	SS 4 30 credits	Total 120 credits
Materialwiss. Vertiefung (Materials Science Major Course)	Microstructure-Property Relationships 6 credits, mPr Materials Characterization 6 credits, mPr	Applied Materials Modeling 6 credits, mPr Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria 6 credits, mPr Solid-state Reactions and Kinetics of Phase Transformations, Corrosion 6 credits, mPr		Master's thesis 30 credits	30 credits
Schwerpunkt I * (Focal Course I)	See 3.2 8 credits, 2 mPr	See 3.2 8 credits, 2 mPr			16 credits
Schwerpunkt II * (Focal Course II)			See 3.2 16 credits, 3 mPr		16 credits
Interdisziplinäre Ergänzung (Interdisciplinary Supplement)		See 1.4 4 credits, m/sPr	See 1.4 8 credits, m/sPr		12 credits
Überfachliche Qualifikationen (Interdisciplinary Qualifications)			HoC/SPZ/FORUM-courses 4 credits, SL		4 credits
	Internship 12 credits				12 credits

* Selection of two from four possible focal courses according to Section 3. The precise amount of credits per semester depends on the courses chosen.

1.4. Options of Courses in the module Technical Specialization of the subject Interdisciplinary Supplement

Course number	Course	Lecturer	SWS	Credits	Control of success	Sem	Language
2306321+ 2306323	Hybride und elektrische Fahrzeuge	Doppelbauer, Richter	3	4	sPr	WS	D
2147175	CAE-Workshop	Albers	3	4	PA	WS/SS	D
2146180	Antriebssystemtechnik A: Fahrzeugantriebstechnik	Albers	2	4	sPr	SS	D
2145150	Antriebssystemtechnik B: Stationäre Antriebssysteme	Albers	2	4	sPr	WS	D
2117500	Energieeffiziente Intralogistiksysteme	Schönung	2	4	mPr	WS	D
2145181	Angewandte Tribologie in der industriellen Produktentwicklung	Albers	2	4	mPr	WS	D
2181114	Tribologie	Scherge/ Dienwiebel	5	8	mPr	WS	D
2113805	Grundlagen der Fahrzeugtechnik I*	Gauterin	4	8	sPr	WS	D
2113809	Automotive Engineering I*	Gauterin/ Gießler	4	8	sPr	WS	E
2113812 + 2114844	Grundsätze der Nutzfahr-zeugentwicklung I+II	Zürn	2	4	mPr	WS/SS	D
2149670	Produkt- und Produktionskonzepte für moderne Automobile	Steegmüller, Kienzle	2	4	mPr	WS	D
2123364	Produkt-, Prozess- und Ressourcenintegration in der Fahrzeugentstehung	Mbang	2	4	sPr	SS	D
2133113	Verbrennungsmotoren I	Kubach	2	4	mPr	WS	D
2134151	Verbrennungsmotoren II	Kubach	3	5	mPr	SS	D
2133108	Betriebsstoffe für motorische Antriebe	Kehrwald	2	4	mPr	WS	D
2189906	Physikalische und chemische Grundlagen der Kernenergie im Hinblick auf Reaktorstörfälle und nukleare Entsorgung	Dagan, Metz	1	2	mPr	WS	D
2189400	Solar Thermal Energy Sys-tems	Dagan	2	4	mPr	WS	E
2157381	Windkraft	Lewald	2	4	sPr	WS	D
2165515+ 2165517	Grundlagen der technischen Verbrennung I*	Maas	3	4	mPr	WS	D
3165016+ 3165017	Fundamentals of Combustion I*	Maas	3	4	mPr	WS	E
2166538+ 2166589	Grundlagen der technischen Verbrennung II	Maas	3	4	mPr	SS	D
2170478	Turbinen-Luftstrahl-Triebwerke	Bauer	2	4	mPr	SS	D
2424152	Robotik I – Einführung in die Robotik	Asfour	4	6	sPr	WS	D
2109035	Arbeitswissenschaft I: Ergonomie	Deml	2	4	sPr	WS	D
2109036	Arbeitswissenschaft II: Arbeitsorganisation	Deml	2	4	sPr	WS	D
2149667	Qualitätsmanagement	Lanza	2	4	sPr	WS	D
2115919	Bahnsystemtechnik	Gratzfeld	2	4	mPr	WS/SS	D

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2115996	Schienenfahrzeugtechnik	Gratzfeld	2	4	mPr	WS/SS	D
2133132	Nachhaltige Fahrzeugantriebe	Toedter	2	4	mPr	WS	D
2106014	Datenanalyse für Ingenieure	Mikut, Reischl	3	5	sPr	SS	D
2169453+ 2169454	Thermische Turbomaschinen I*	Bauer	5	6	mPr	WS	D
2169553+ 2169454	Thermische Turbomaschinen I (auf Englisch) *	Bauer	5	6	mPr	WS	E
2170476+ 2170477	Thermische Turbomaschinen II*	Bauer	3	6	mPr	SS	D
2170553+ 2170477	Thermische Turbomaschinen II (auf Englisch) *	Bauer	5	6	mPr	SS	E
2121350	Product Lifecycle Management	Ovtcharova	2	4	sPr	WS	D
2121001	Technische Informationssysteme	Ovtcharova	3	5	mPr	SS	D
2161212+ 2161213	Technische Schwingungslehre	Fidlin	4	5	sPr	WS	D
2146190	Konstruktiver Leichtbau	Albers	2	4	mPr	SS	D
2143882	Fertigungsprozesse der Mikrosystem-technik	Bade	2	4	mPr	WS/SS	D
2141864	BioMEMS-Mikrosystemtechnik für Life-Sciences und Medizin: I	Guber	2	4	mPr	WS	D
2142883	BioMEMS-Mikrosystemtechnik für Life-Sciences und Medizin: II	Guber	2	4	mPr	SS	D
2142879	BioMEMS-Mikrosystemtechnik für Life-Sciences und Medizin: III	Guber	2	4	mPr	SS	D
2125763	Struktur- und Phasenanalyse	Wagner	2	4	mPr	WS	D
4027111+2 4027021+2	Elektronenmikroskopie I+II (mit Übungen)	Eggeler	8	16	mPr	SS/WS	D
2142140	Bionik für Ingenieure und Naturwissenschaftler	Hölscher	2	4	mPr	SS	D
2313760	Fabrication and Characterisation of Optoelectronic Devices	Richards	2	3	sPr	SS	E
4044021+ 4044022	Fundamentals of Optics and Photonics	Hunger	6	8	sPr	WS	E
7148	Basic Molecular Cell Biology	Weth	2	2	sPr	SS	E
3137020 + 3137021	Measurement and Control Systems	Stiller	4	6	sPr	WS	E
2141853	Polymers in MEMS A - Chemistry, Synthesis and Applications	Rapp	2	4	mPr	WS	D/E
2141854	Polymers in MEMS B - Physics, Manufacturing and Applications	Worgull	2	4	mPr	WS	D/E
2142855	Polymers in MEMS C - Biopolymers and Bioplastics	Worgull	2	4	mPr	SS	D/E

* The following courses cannot be combined:
- Grundlagen der Fahrzeugtechnik I and Automotive Engineering I
- Grundlagen der technischen Verbrennung I and Fundamentals of Combustion I

- Thermische Turbomaschinen I and Thermische Turbomaschinen I (auf Englisch)
- Thermische Turbomaschinen II and Thermische Turbomaschinen II (auf Englisch)

1.5. Master’s Thesis Module

The master’s thesis module consists of a master’s thesis and a presentation of the background and scientific contents of the master‘s thesis. The presentation is to have a duration of 30 minutes, followed by a scientific discussion with the responsible supervisors and the public. The presentation and discussion will be considered when determining the total grade of the master’s thesis module. Registration for the master’s thesis has to take place via the Students Portal (Campus Management).

2. Internship

2.1. Contents and Organization of the Internship

Within the master’s program, an internship must be passed according to SPO Article 14a. The internship is to provide insights into and experience in engineering work. The internship must have a minimum duration of 9 weeks. In any case, lost working time must be compensated. In case of lost working time, the intern should ask the company for an extension of the contract for him/her to be able to continue the internship as required.

The Internship Office (Praktikantenamt) does not find and offer internship places. The students themselves have to contact a company and ask for an internship place. The internship relationship becomes legally binding by the conclusion of a training contract (Ausbildungsvertrag) between the company and the intern. This contract defines all rights and obligations of the intern and the training company as well as the type and duration of the internship. In this connection, company is to be understood as a synonym of engineering offices, enterprises, authorities, etc. It is not permitted to pass an internship at an institution of KIT.

To ensure a sufficient scope of practical training, the intern must work in at least two different areas.

It may be chosen among the following areas:
- Werkstoffentwicklung (materials development)
- Werkstoffprüfung / Qualitätskontrolle (materials testing / quality control)
- Materialsynthese (materials synthesis)
- Werkstoffauswahl im Produktentstehungsprozess (materials selection in the product development process)
- Metallurgie / Pulvermetallurgie (metallurgy / powder metallurgy)
- Urformtechnik (molding)
- Umformtechnik (forming)
- Oberflächentechnik (surface treatment)
- Wärmebehandlung (thermal treatment)
- andere werkstofftechnische Tätigkeitsgebiete (nach Rücksprache mit dem Praktikantenamt der KIT-Fakultät für Maschinenbau) (other areas of materials engineering (upon agreement with the Internship Office of the KIT Department of Mechanical Engineering)).

2.2. Recognition of the Internship

For recognition of the internship, the original training contract and the original proof of activity have to be submitted. The types and durations of the individual activities must be clearly obvious from the documents. For recognition of the internship, an internship certificate (Praktikantenzeugnis) issued by the training company is required, which describes the types and durations of the activities during the internship. Days of absence have to be indicated. In addition, recognition of the internship requires the chairperson of the examination committee or an examiner according to Article 17, par. 2, SPO to confirm completion of the internship by a report and short presentation.

Students having acquired the university entrance qualification in Germany (Bildungsinländer) are strongly recommended to pass the complete or part of the internship abroad. Internships at foreign companies will only be recognized, however, if they comply with with the above regulations.

3. Focal Courses

3.1. Scope and Structure

In the master's program, two different Schwerpunkte (focuses) have to be chosen, in which at least 16 credits each are acquired. The amount of 16 credits may be exceeded once only by registration of a partial achievement. It is not permitted to register additional partial achievements, if 16 credits have already been exceeded. Within a focus, at least 12 credits must be acquired by graded controls of success and at least 8 credits must be chosen from courses marked by "X". The focus grade is calculated from the completed graded partial modules.

In any case, all partial module grades are weighed according to their credits when determining the focus grade. When calculating the total grade, every focus is evaluated with 16 credits.

The combinations chosen from the selectable controls of success / partial achievements of the different focuses given below must be presented to the examination committee for approval. Deviating combinations may be permitted, but require the prior approval by the focus coordinators. The template to be used for the approval of focuses is given at the end of this studies plan. The courses listed with English titles in the course catalogs are held in English.

3.2. Focal Courses (SP) and corresponding options

SP1: Konstruktionswerkstoffe (Structural Materials) Coordinator: Professor Heilmaier

Course number		Course	Lecturer	SWS	Credits	Control of success	Sem	Language
new	X	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	Henning	2	4	sPr	SS	E
2125751		Praktikum "Technische Keramik"	Schell	2	4	SL	WS	D
2126749	X	Pulvermetallurgische Hochleistungswerkstoffe	Schell	2	4	mPr	SS	D
2173580		Mechanik und Festigkeitslehre von Kunststoffen	von Bernstorff	2	4	mPr	WS	D
2173586	X	Schwingfestigkeit	Guth	2	4	mPr	SS	D
2174571		Konstruieren mit Polymerwerkstoffen	Liedel	2	4	mPr	SS	D
2174574	X	Werkstoffe für den Leichtbau	Liebig	2	4	mPr	SS	D
2174579	X	Technologie der Stahlbauteile	Schulze	2	4	mPr	SS	D
2175590		Experimentelles metallographisches Praktikum	Mühl	3	4	SL	Ww	D
2177618	X	Superharte Dünnschichtmaterialien*	Ulrich	2	4	mPr	WS	D
2194729	X	Superhard Thin Film Materials*	Ulrich	2	4	mPr	SS	E
2194643	X	Aufbau und Eigenschaften verschleißfester Werkstoffe*	Ulrich	2	4	mPr	SS	D
2181712	X	Nanotribologie und –mechanik	Dienwiebel / Hölscher	2	4	PA	Ww	D/E
2181745		Auslegung hochbelasteter Bauteile	Aktaa	2	4	mPr	WS	D
2193055	X	High Temperature Corrosion	Gorr	2	4	mPr	WS	E
new		Vehicle Lightweight Design - Strategies, Concepts, Materials	Henning	2	4	sPr	WS	E
2181750		Plastizität auf verschiedenen Skalen	Schulz/Greiner	2	4	PA	WS	D
2182572	X	Schadenskunde	Schneider/Greiner	2	4	mPr	WS	D
2181708		Biomechanik: Design in der Natur und nach der Natur	Mattheck	2	4	SL	WS	D
2173583	X	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement**	Pundt	2	4	mPr	SS	E
2173584	X	Hydrogen in Materials: Exercises and Lab Course***	Wagner	1	4	SL	SS	E
2174572	X	Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung**	Pundt	2	4	mPr	WS	D
2174573	X	Wasserstoff in Materialien: Übungen und Laborkurs***	Wagner	2	4	SL	WS	D
2173600	X	Werkstoffe in der additiven Fertigung	Dietrich	2	4	mPr	WS	D
2173648	X	Plasticity of Metals and Intermetallics	Kauffmann	4	8	mPr	SS	E
2174605	X	High Temperature Materials	Heilmaier	2	4	mPr	WS	E
2193051	X	Thermophysics of Advanced Materials	Sergeev	2	4	mPr	ww	E
2173421	X	Phase Transformations in Materials	Heilmaier/ Kauffmann	2	4	mPr	WS	E
2174555	X	Materialkunde der Nichteisenmetalle	Heilmaier/Gorr	3	4	mPr	SS	D
2173573	X	Thin Films – Preparation, Structure, Thermodynamics	Wagner	2	4	mPr	WS	E

2186100	X	Jenseits konventioneller Werkstoffe - Metamaterialien und 3D strukturierte Bauteile	Bauer	2	4	mPr	WS	E

* Only one of the three controls of success / partial achievements “Superharte Dünnschichtmaterialien“, “Superhard Thin Film Materials” and “Aufbau und Eigenschaften verschleißfester Werkstoffe“ may be completed within the focal course SP1.

** Only one of the two partial achievements “Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement“ and “Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung“ may be completed in the focal course SP1.

*** Only one of the two partial achievements “Hydrogen in Materials: Exercises and Lab Course “ and “Wasserstoff in Materialien: Übungen und Laborkurs “ may be completed in the focal course SP1.

SP2: Computational Materials Science Coordinator: Professor Nestler

Course number		Course	Lecturer	SWS	Credits	Control of success	Sem	Language
2183717	X	Seminar Werkstoffsimulation / Seminar Materials Simulation (mandatory)	Gumbsch / Nestler / Böhlke	4	8	PA	WS/SS	D/E
2181740	X	Atomistic Simulations and Particle Dynamics	Gumbsch	3	4	mPr	SS	E
2183702	X	Mikrostruktursimulation	Nestler / Weygand / August	3	4	mPr	WS	D
2183721	X	High Performance Computing	Nestler / Selzer	2	4	sPr	WS/SS	D
2162282+ 2162257	X	Einführung in die Finite-Elemente-Methode	Böhlke / Langhoff	3	6	sPr	SS	D
2161250+ 2161147	X	Rechnerunterstützte Mechanik I	Böhlke / Langhoff	4	6	mPr	WS	D
2162296+ 2162297	X	Rechnerunterstützte Mechanik II	Böhlke / Langhoff	4	6	mPr	SS	D
2182732	X	Einführung in die Materialtheorie	Kamlah	2	4	mPr	SS	D
2181720	X	Grundlagen der nichtlinearen Kontinuumsmechanik	Kamlah	2	4	mPr	WS	D
2181738	X	Wissenschaftliches Programmieren für Ingenieure	Weygand / Gumbsch	2	4	mPr	WS	D
2182740	X	Werkstoffmodellierung: Versetzungsbasierte Plastizität	Weygand	2	4	mPr	SS	D
2182741	X	Data Science and Scientific Workflows	Gumbsch / Weygand	3	4	SL, mPr	SS	D
6215903 / 6215904	X	Bruch- und Schädigungsmechanik	Seelig	4	6	mPr	SS	D
2181745	X	Auslegung hochbelasteter Bauteile	Aktaa	2	4	mPr	WS	D
2162280 +2162281	X	Mathematische Methoden der Mikromechanik	Böhlke	3	6	sPr	SS	D
2162344	X	Nonlinear Continuum Mechanics	Böhlke	3	4	mPr	SS	E
2305263+ 2305265	X	Electromagnetics and Numerical Calculation of Fields	Dössel	3	4	sPr	WS	E
4023141+ 4023142	X	Simulation nanoskaliger Systeme	Wenzel	3	6	mPr	SS	D
4023021+ 4023022		Computational Photonics	Rockstuhl	4	6	mPr	WS	E
4023151+ 4023152		The ABC of DFT	Wenzel	3	6	mPr	SS	E
4023161+ 4023162		Computational Condensed Matter Physics	Wenzel	6	12	mPr	SS	E
2142875		Mikrosystem Simulation	Korvink	3	4	sPr	SS	E

Passing of the partial achievement “Seminar Werkstoffsimulation" (can be taken in German or English) is mandatory in focal course SP2. The remaining credits may be chosen from the list of other controls of success / partial achievements.

SP3: Materialprozesstechnik (Materials Processing) Coordinator: Professor Schulze

Course number		Course	Lecturer	SWS	Credits	Control of success	Sem	Language
2149657	X	Fertigungstechnik	Schulze	6	8	sPr	WS	D
2174575		Gießereikunde	Klan/Günther	2	4	sPr	SS	D
2173571		Schweißtechnik	Farajian	2	4	mPr	WS	D
2173590	X	Polymerengineering I	Elsner	2	4	mPr	WS	D
2174596	X	Polymerengineering II	Elsner	2	4	mPr	SS	D
2193010	X	Grundlagen der Herstellungsverfahren der Keramik und Pulvermetallurgie	Schell	2	4	mPr	WS	D
22948 /22990		Materialien für elektrochemische Speicher und Wandler	Tübke	2	4	mPr	WS/SS	D
2177601	X	Aufbau und Eigenschaften von Schutzschichten	Ulrich	2	4	mPr	WS	D
2182642	X	Laser Material Processing	Schneider	2	4	mPr	SS	E
2150681		Umformtechnik	Herlan	2	4	mPr	SS	D
2173560		Experimentelles schweißtechnisches Praktikum, in Gruppen	Schulze / Dietrich	3	4	SL	WS	D
2173520	X	Werkstoffrecycling und Nachhaltigkeit	Liebig	2	4	mPr	SS	D
2113110	X	Leichtbau mit Faser-Verbund-Kunststoffen – Theorie und Praxis	Kärger/ Liebig	2	4	mPr	WS	D
2114107	X	Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile	Kärger	2	4	mPr	SS	D
2149700		Projektpraktikum Additive Fertigung: Entwicklung und Fertigung eines additiven Bauteils	Zanger	2	4	PA	WS	D
2150550		Praktikum Produktionsintegrierte Messtechnik	Lanza	3	4	PA	SS	D
22929 + 22930	X	Additive Manufacturing for Process Engineering + Practical	Klahn	3	6	mPr	SS	E
2141861	X	Introduction to Microsystem Technology I	Korvink	2	4	sPr	WS	E
2142874	X	Introduction to Microsystem Technology II	Korvink	2	4	sPr	SS	E
2301478	X	Laser Metrology	Eichhorn	2	3	mPr	SS	E
2141501	X	Mikro NMR Technologie	Korvink	2	4	PA	WS	E
2311629+ 2311631	X	Optical Engineering	Stork	3	4	mPr	WS	E

SP4: Funktionswerkstoffe (Functional Materials) Coordinator: Professor Ehrenberg

Course number		Course	Lecturer	SWS	Credits	Control of success	Sem	Language
2304207+ 2304213	X	Batterien und Brennstoffzellen*	Weber	3	5	mPr	WS	D
2304231	X	Sensoren	Menesklou	2	3	sPr	WS	D
2304240	X	Sensorsysteme	Wersing	2	3	mPr	SS	D
2313737	X	Photovoltaik**	Powalla	4	6	sPr	SS	D
2313726+ 2313728	X	Optoelektronik	Lemmer	3	4	mPr	SS	D
2313734		Grundlagen der Plasmatechnologie	Kling	2	4	mPr	SS	D
2141865	X	Neue Aktoren und Sensoren	Kohl / Sommer	2	4	mPr	WS	D
4021011	X	Elektronische Eigenschaften von Festkörpern I	Weber / Weiß	4	8	mPr	WS	D
4021111		Elektronische Eigenschaften von Festkörpern II	Ustinov	2	4	mPr	SS	D
5404		Spektroskopie mit Elektronen und weichen Röntgenstrahlen	Heske / Weiinhardt	2	4	mPr	SS	D
5439		Moderne Charakterisierungs-methoden zur Charakterisierung von Materialien und Katalysatoren	Grunwaldt / Kleist / Lichtenberg	2	4	mPr	WS	D
23660	X	VLSI-Technologie	Siegel	2	4	mPr	WS	D
2312700+ 2312701	X	Bauelemente der Elektrotechnik	Kempf	4	6	sPr	WS	D
2126784		Funktionskeramiken	Hinterstein	2	4	mPr	WS	D
new	X	Mechanische Eigenschaften von Nanomaterialien und Mikrosystemen	Gruber/ Kirchlechne r/ Weygand	2	4	mPr	WS	D
2178420	X	Mechanical Properties of Nanomaterials and Microsystems	Gruber/ Kirchlechne r/ Weygand	2	4	mPr	SS	E
2312717 + +2312696	X	Superconducting Materials***	Holzapfel	4	6	mPr	WS/ SS	E
2312708 +2312709	X	Superconductivity for Engineers***	Holzapfel/ Kempf	3	5	sPr	WS/ SS	E
2312698	X	Superconducting Magnet Technology	Arndt	3	4	mPr	SS	E
2314011	X	Superconducting Power Systems	Noe	3	4	mPr	WS	E
2193013		Lasergestützte Methoden und deren Einsatz für Energiespeichermaterialien	Pfleging	2	4	mPr	ww	D
2193007	X	Materialien und Werkstoffe für die Energiewende****	Seifert	2	4	mPr	WS	D
2193008	X	Engineering Materials for the Energy Transition****	Franke/Seif ert	2	4	mPr	SS	E
2313709	X	Plastic Electronics / Polymerelektronik	Lemmer	2	3	mPr	WS	E
5072	X	Batteries and Fuel Cells*	Ehrenberg / Scheiba	2	4	mPr	WS	E
5073	X	Hydrogen as Energy Carrier	Ehrenberg / Leon	2	4	mPr	WS	E
2313745+ 2313750	X	Solar Energy**	Richards	4	6	sPr	WS	E
4020011	X	Solid State Optics	Hetterich	4	8	mPr	WS	E
2312680+ 2312694	X	Single-Photon-Detectors	Ilin	3	4	mPr	WS	E
4020021+ 4020022	X	Nano Optics	Naber	4	8	mPr	WS	E
2309486+ 2309487	X	Optoelectronic Components	Freude	3	4	mPr	SS	E

4023011+ 4023012	X	Theoretical Quantum Optics	Rockstuhl	3	6	mPr	WS	E
2313724	X	Adaptive Optics	Gladysz	2	3	mPr	WS	E
2313747+ 2313749	X	Light and Display Engineering	Kling	3	4	mPr	WS	E
2309464+ 2309465	X	Optical Waveguides and Fibers	Koos	3	4	mPr	WS	E
2309460+ 2309461	X	Optical Transmitters and Receivers	Freude	4	6	mPr	WS	E
2312670+ 2312675	X	Thin films: technology, physics and applications I	Ilin	3	4	mPr	WS	E
2312671+ 2312673	X	Thin films: technology, physics and applications II	Ilin	3	4	mPr	SS	E

* Only one of the two partial achievements “Batterien und Brenstoffzellen“ and “Batteries and Fuel Cells“ may be completed in the focal course SP4.

** Only one of the two partial achievements “Solar Energy“ and “Photovoltaik“ (photovoltaics) may be completed in the focal course SP4.

*** Only one of the two partial achievements “Superconducting Materials“ and “Superconductivity for Engineers“may be completed in the focal course SP4.

**** Only one of the two partial achievements “Materialien und Werkstoffe für die Energiewende“ and Engineering Materials for the Energy Transition ““ may be completed in the focal course SP4.

3 Field of study structure

Mandatory	
Master's Thesis	30 CR
Internship	12 CR
Materials Science Major Course	30 CR
Focal Course I	16 CR
Focal Course II	16 CR
Interdisciplinary Supplement	12 CR
Interdisciplinary Qualifications	4 CR
Voluntary	
Additional Examinations *This field will not influence the calculated grade of its parent.*	

3.1 Master's Thesis

Credits
30

Mandatory		
M-MACH-103835	Master's Thesis	30 CR

3.2 Internship

Credits
12

Mandatory		
M-MACH-103838	Internship	12 CR

3.3 Materials Science Major Course

Credits
30

Mandatory		
M-MACH-103710	Thermodynamics	6 CR
M-MACH-103711	Kinetics	6 CR
M-MACH-103712	Simulation	6 CR
M-MACH-103713	Properties	6 CR
M-MACH-103714	Materials Characterization	6 CR

3.4 Focal Course I

Credits
16

Focal Course I (Election: 1 item)		
M-MACH-103738	Structural Materials	16 CR
M-MACH-103739	Computational Materials Science	16 CR
M-MACH-103740	Materials Processing	16 CR
M-MACH-103741	Functional Materials	16 CR

3.5 Focal Course II

Credits
16

Focal Course II (Election: 1 item)		
M-MACH-103738	Structural Materials	16 CR
M-MACH-103739	Computational Materials Science	16 CR
M-MACH-103740	Materials Processing	16 CR
M-MACH-103741	Functional Materials	16 CR

3.6 Interdisciplinary Supplement

Credits
12

Mandatory		
M-MACH-103715	Technical Specialisation	12 CR

3.7 Interdisciplinary Qualifications

Credits
4

Mandatory		
M-MACH-103721	Key Competencies	4 CR

3.8 Additional Examinations

Additional Examinations (Election: at most 30 credits)		
M-FORUM-106753	Supplementary Studies on Science, Technology and Society *First usage possible from Oct 01, 2024.*	16 CR

4 Modules

M 4.1 Module: Computational Materials Science [M-MACH-103739]

Responsible: Prof. Dr. Britta Nestler
Organisation: KIT Department of Mechanical Engineering
Part of: Focal Course I
Focal Course II

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	2 terms	German	4	7

Mandatory			
T-MACH-107660	Seminar "Materials Modelling"	8 CR	Nestler, Schulz
T-MACH-113814	Seminar Materials Simulation	8 CR	Nestler, Schulz
Compulsary Elective Studies (Election: at least 8 credits)			
T-MACH-113412	Atomistic Simulations and Particle Dynamics	4 CR	Gumbsch, Schneider, Weygand
T-MACH-105310	Design of Highly Stressed Components	4 CR	Aktaa
T-BGU-100087	Fracture and Damage Mechanics	6 CR	Seelig
T-PHYS-109895	Computational Condensed Matter Physics	12 CR	Wenzel
T-PHYS-106131	Computational Photonics, without ext. Exercises	6 CR	Rockstuhl
T-MACH-111588	Data Science and Scientific Workflows	3 CR	Gumbsch, Weygand
T-MACH-111603	Data Science and Scientific Workflows (Project)	1 CR	Gumbsch, Weygand
T-MACH-105320	Introduction to the Finite Element Method	3 CR	Böhlke, Langhoff
T-MACH-110330	Tutorial Introduction to the Finite Element Method	1 CR	Böhlke, Langhoff
T-MACH-105321	Introduction to Theory of Materials	4 CR	Kamlah
T-ETIT-100640	Electromagnetics and Numerical Calculation of Fields	4 CR	Zwick
T-MACH-105324	Foundations of Nonlinear Continuum Mechanics	4 CR	Kamlah
T-MACH-105398	High Performance Computing	4 CR	Nestler, Selzer
T-MACH-110378	Mathematical Methods in Micromechanics	5 CR	Böhlke
T-MACH-110379	Tutorial Mathematical Methods in Micromechanics	1 CR	Böhlke
T-MACH-108383	Microsystem Simulation	4 CR	Korvink
T-MACH-105303	Modelling of Microstructures	4 CR	August, Nestler
T-MACH-111026	Nonlinear Continuum Mechanics	6 CR	Böhlke
T-MACH-111027	Tutorial Nonlinear Continuum Mechanics	2 CR	Böhlke
T-MACH-105351	Computational Mechanics I	6 CR	Böhlke, Langhoff
T-MACH-105352	Computational Mechanics II	6 CR	Böhlke, Langhoff
T-PHYS-102504	Simulation of Nanoscale Systems, without Seminar	6 CR	Wenzel
T-PHYS-105960	The ABC of DFT	6 CR	Rockstuhl, Wenzel
T-MACH-105369	Materials Modelling: Dislocation Based Plasticity	4 CR	Weygand
T-MACH-100532	Scientific Computing for Engineers	4 CR	Gumbsch, Weygand

Competence Certificate
The success controls usually include an “Alternative academic assessment” in the form of a seminar paper including a presentation (obligatory course “Seminar Materials Modelling") as well as three oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses

Prerequisites
None

Competence Goal
After attending the emphasis "Computational Materials Science" the students will gain the following skills

- They can independently elaborate a scientific problem in the field of "Computational Materials Science".
- They can choose suitable methods as well as techniques and use or refine them to solve his problem.

The individual learning outcomes depend very much on the lectures chosen within the emphasis "Computational Materials Science" and therefore are explicitly described there.

Content
Within the emphasis "Computational Materials Science" are presented the basics of different modeling and simulation methods, which can be used to elaborate problems from the field of "Computational Materials Science" at different length scales.

For detailed information see the description of the different courses of the module.

Workload
The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

Learning type
Lectures, Lab Courses, Seminars

Level 4

M 4.2 Module: Functional Materials [M-MACH-103741]

Responsible: Prof. Dr. Helmut Ehrenberg
Organisation: KIT Department of Mechanical Engineering
Part of: Focal Course I
Focal Course II

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	2 terms	German	4	14

Compulsary Elective Studies "X" (Election: at least 8 credits)			
T-ETIT-107644	Adaptive Optics	3 CR	Gladysz, Lemmer
T-ETIT-100983	Batteries and Fuel Cells	5 CR	Krewer
T-CHEMBIO-112316	Batteries and Fuel Cells	4 CR	Ehrenberg
T-ETIT-109292	Electrical Engineering Components	6 CR	Kempf
T-PHYS-102578	Electronic Properties of Solids I, without Exercises	8 CR	Le Tacon, Wernsdorfer, Wulfhekel
T-MACH-112691	Engineering Materials for the Energy Transition	4 CR	Seifert
T-CHEMBIO-112317	Hydrogen as Energy Carrier	4 CR	Ehrenberg
T-ETIT-100644	Light and Display Engineering	4 CR	Kling
T-MACH-109082	Engineering Materials for the Energy Transition	4 CR	Seifert
T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems	4 CR	Gruber, Kirchlechner, Weygand
T-MACH-114071	Mechanical Properties of Nanomaterials and Microsystems	4 CR	Gruber, Kirchlechner, Weygand
T-MACH-102152	Novel Actuators and Sensors	4 CR	Kohl, Sommer
T-ETIT-100639	Optical Transmitters and Receivers	6 CR	Freude
T-ETIT-101945	Optical Waveguides and Fibers	4 CR	Koos
T-ETIT-101907	Optoelectronic Components	4 CR	Randel
T-ETIT-100767	Optoelectronics	4 CR	Lemmer
T-PHYS-102282	Nano-Optics	8 CR	Naber
T-ETIT-101939	Photovoltaics	6 CR	Powalla
T-ETIT-100763	Plastic Electronics / Polymerelectronics	4 CR	Lemmer
T-ETIT-101911	Sensors	4 CR	Menesklou
T-ETIT-100709	Sensor Systems	4 CR	Menesklou
T-ETIT-108390	Single-Photon Detectors	4 CR	Ilin
T-ETIT-100774	Solar Energy	6 CR	Richards
T-PHYS-104773	Solid-State Optics, without Exercises	8 CR	Hetterich
T-ETIT-113440	Superconducting Magnet Technology	4 CR	Arndt
T-ETIT-111096	Superconducting Materials	6 CR	Holzapfel
T-ETIT-113439	Superconducting Power Systems	4 CR	Noe
T-ETIT-111239	Superconductivity for Engineers	5 CR	Holzapfel, Kempf
T-PHYS-110303	Theoretical Quantum Optics	6 CR	Metelmann, Rockstuhl
T-ETIT-106853	Thin Films: Technology, Physics and Applications I	4 CR	Ilin
T-ETIT-108121	Thin Films: Technology, Physics, and Applications II	3 CR	Ilin
Compulsary Elective Studies PL without "X" (Election:)			
T-PHYS-104423	Electronic Properties of Solids II, without Exercises	4 CR	Le Tacon, Rotzinger, Ustinov, Wernsdorfer
T-MACH-105179	Functional Ceramics	4 CR	Botros
T-ETIT-100770	Fundamentals on Plasma Technology	4 CR	Kling
T-MACH-106739	Laser-Assisted Methods and Their Application for Energy Storage Materials	4 CR	Pfleging

T-CHEMBIO-107822	Modern Characterization Methods for Materials and Catalysts	4 CR	
T-CHEMBIO-107821	Spectroscopy with Electrons and Soft X-rays	4 CR	

Competence Certificate
The success controls usually include four oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses.

Prerequisites
Of the courses "Solarenergy" and "Photovoltaics" only one can be selected.

Of the courses "Superconducting Materials", "Superconducting Systems of Energy Technologies", and "Superconducting Materials of Energy Applications" only one can be selected.

Competence Goal
Students aquire special basic knowledge in selected areas of materials science and engineering and can apply them to technical problems. The specific teaching objectives are agreed with the respective coordinator of the course.

Content
see respective courses

Workload
The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

Recommendation
Good physical and electrical basic knowledge

Learning type
Lectures, Lab Courses, Seminars

Level 4

M 4.3 Module: Internship [M-MACH-103838]

Responsible: Dr. Patric Gruber
Organisation: KIT Department of Mechanical Engineering
Part of: Internship

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
12	pass/fail	Each term	2 terms	German	4	1

Mandatory			
T-MACH-107764	Internship	12 CR	Gruber

Competence Certificate
Presentation of the internship documents (training contract, activity report, internship certificate) as well as placement of an internship report in the form of a short oral presentation (about 10 min) and a written report (2-3 pages respectively 6-8 sheets, text included).

Prerequisites
None

Competence Goal
The students gain a first insight into industrial practice. They can apply their previously learned skills to problems in practice. The students get to know different fields of activity of a company. Thus, they are able to assess the requirements of different tasks and can use this knowledge for their future career choices.

Content
In order to ensure an adequate breadth of work experience, activities from at least two different areas of materials science must be proven.

The activities may be composed of the following areas:

- Materials development
- Materials testing / quality assessment
- Materials synthesis
- Materials selection in product design and processing
- Metallurgy / Powder metallurgy
- Primary shaping technology
- Forming technology
- Surface technology
- Heat treatment
- alternative working area in materials engineering (after consulting the examination board)

Annotation
As part of the master's program, an internship must be completed in accordance with SPO § 14a. The compulsory minimum duration is 9 weeks full time. Missed working hours must be made up in any case. In the case of time off, the trainee should ask the training company for a contract extension in order to be able to get the work experience to the required extent.

The internship office does not convey internships. The students have to contact a company and ask for a suitable internship. The internship relationship becomes legally binding through the training contract to be concluded between the company and the trainee. The contract defines all rights and obligations of the trainee and the training company as well as the type and duration of the work experience. The term “company” is synonymous here with engineering firms, enterprises, authorities etc. However, the internship cannot be completed at a KIT facility.

Workload
Presence time in the company: 9 weeks x 40 h/week = 360 h

Learning type
Professional practical training

M 4.4 Module: Key Competencies [M-MACH-103721]

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

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
4	pass/fail	Each term	2 terms	German	4	2

Key Competencies (Election:)			
T-MACH-112686	Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded	1 CR	Heilmaier
T-MACH-112687	Self-Booking-MSc-HOC-SPZ-FORUM-Graded	1 CR	Heilmaier
T-MACH-113321	Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded	1 CR	Heilmaier
T-MACH-113322	Self-Booking-MSc-HOC-SPZ-FORUM-Graded	1 CR	Heilmaier
T-MACH-113323	Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded	1 CR	Heilmaier
T-MACH-113324	Self-Booking-MSc-HOC-SPZ-FORUM-Graded	1 CR	Heilmaier

Prerequisites
None

Competence Goal
After completing the module "Key Competences", students can:

- define and coordinate work steps, projects and goals, proceed systematically and purposefully, set priorities, identify insignificance and assess the feasibility of a task,
- apply the principles of safeguarding good scientific practice,
- describe and apply methods for planning a specific task under given conditions in a goal-oriented and resource-oriented manner,
- describe methods for scientific research and selection of subject information according to pre-established quality criteria and apply them to given problems,
- professionally evaluate the quality of a reference,
- discuss empirical methods and apply them to selected examples,
- present technical information in a clear, legible and convincingly argued manner in various forms (e.g. poster, exposé, abstract) in writing and visualize it graphically (e.g. design drawings, flowcharts),
- present and defend technical content in a convincing and appealing way
- work in a heterogeneous team in a task-oriented manner, manage and solve conflicts on their own and take responsibility for themselves and others,
- communicate constructively in a team in a goal-oriented and interpersonal manner, represent one's own interests, reflect and take into account the interests of others in their own words, and successfully form the course of the conversation.

Content
The module "Key Competences" form freely selectable courses from the offer of the KIT-House of Competence (HoC), the KIT Language Center (SPZ) and the Studium Generale at the Forum Wissenschaft und Gesellschaft (FORUM, formerly ZAK) with a total of at least 4 credits. Upon request, the Examination Board may approve further courses as elective subjects in the module "Key Competences".

Workload
The work load results from the sum of work loads of the chosen courses.

M 4.5 Module: Kinetics [M-MACH-103711]

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

Part of: Materials Science Major Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	1 term	German/English	4	4

Election notes
The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language.

Compulsory Elective Subjects (Election: 2 items as well as 6 credits)			
T-MACH-107632	Exercises for Solid State Reactions and Kinetics of Phase Transformations	2 CR	Franke, Seifert
T-MACH-107667	Solid State Reactions and Kinetics of Phase	4 CR	Franke, Seifert
T-MACH-110926	Exercises for Solid State Reactions and Kinetics of Phase Transformations	2 CR	Gorr
T-MACH-110927	Solid State Reactions and Kinetics of Phase Transformations	4 CR	Gorr

Competence Certificate
The assessment consists of a certificate and an oral exam (about 30 minutes).

Prerequisites
none

Competence Goal
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

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

Module grade calculation
The module grade is equal to the grade of the oral exam.

Annotation
The participation in Exercises for Solid State Reactions and Kinetics of Phase Transformations is obligatory.

Workload
The workload for the module “Kinetics” 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).

Recommendation
- Basic course in materials science and engineering
- Basic course in mathematics
- physics or physical chemistry

Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (Seifert).

Learning type
Lectures (Obligatory)
Tutorials (Obligatory)

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.

M 4.6 Module: Master's Thesis [M-MACH-103835]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering
Part of: Master's Thesis

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
30	Grade to a tenth	Each term	1 term	German	4	2

Mandatory			
T-MACH-107759	Master's Thesis	30 CR	Heilmaier

Competence Certificate
The module Master Thesis consists of a written master thesis and an oral presentation of a scientific subject chosen by the student himself/herself or given by the supervisor. The master thesis is designed to show that the student is able to deal with a problem of his/her subject area in an independent manner and within the given period of time using scientific methods.

The maximal processing time of the master thesis takes three months. With consent of the examiner the thesis can be written in another language than German as well. The date of issue of the subject has to be fixed by the supervisor and the student and to be put on record at the examination board. The subject of the master thesis may be only returned once and only within the first month of processing time.

On a reasoned request of the student, the examination board can extend the processing time by up to one month. If the master thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.

The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG or habilitated members of the KIT Department of Mechanical Engineering and another examiner. Generally, one of the two examiners is the person who has assigned the thesis.

If the examiners do not agree, the master thesis is graded by the examination board within this assessment; another expert can be appointed too. The master thesis has to be graded within a period of eight weeks after the submission.

The colloquium presentation must be held within 4 weeks after the submission of the master thesis. The presentation should last around 30 minutes and is followed by a scientific discussion with the present expert audience.

Prerequisites
The requirement for admission to the master thesis module are 75 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 75 credits in the following fields:
    - Internship
    - Interdisciplinary Supplement
    - Materials Science Major Course
    - Focal Course I
    - Focal Course II
    - Interdisciplinary Qualifications

Competence Goal
The student is able to work independently on a defined, subject-relevant theme based on scientific criteria within a given period of time. The student is able to do research independently, to analyze information, to abstract as well as collect and recognize basic principles and regularities on the basis of less structured information. He/she overviews the given scientific question, is able to choose sophisticated scientific methods and techniques, and use them to solve this question and to identify further potentials, respectively. In addition, this will be carried out in consideration of social and/or ethical aspects.

The student can interpret, evaluate, and if needed plot the results obtained in a more sophisticated way. He/she is able to clearly structure his scientific work and (a) to communicate it in written form using state-of-the-art technical terminology as well as (b) to present it in oral form and discuss it with experts.

Content
The student shall be allowed to make suggestions for the topic of his/her master thesis. The topic is set by the supervisor of the thesis in accordance with § 14 (3) SPO.

Workload
The workload for the preparation and presentation of the master thesis is about 900 hours.

M 4.7 Module: Materials Characterization [M-MACH-103714]

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: Materials Science Major Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	1 term	German/English	4	4

Election notes
The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses (“exercises“) are compulsory and are a prerequisite for the superordinate course in the same teaching language.

Compulsory Elective Subjects (Election: 2 items as well as 6 credits)			
T-MACH-107684	Materials Characterization	4 CR	Gibmeier, Schneider
T-MACH-107685	Exercises for Materials Characterization	2 CR	Gibmeier, Schneider
T-MACH-110946	Materials Characterization	4 CR	Gibmeier, Schneider
T-MACH-110945	Exercises for Materials Characterization	2 CR	Gibmeier, Schneider

Competence Certificate
The assessment consists of a certificate and an oral exam (about 25 minutes).

Prerequisites
none

Competence Goal
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.

Content
The following methods will be introduced within this module:

- 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).

Learning type
Lectures (Obligatory)
Tutorials (Obligatory)

Literature
Lecture notes (will be provided at the beginning of the lecture).

Literature will be announced at the beginning of the lecture.

M 4.8 Module: Materials Processing [M-MACH-103740]

Responsible: Prof. Dr.-Ing. Volker Schulze
Organisation: KIT Department of Mechanical Engineering
Part of: Focal Course I
Focal Course II

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	2 terms	German	4	8

Compulsary Elective Studies "X" (Election: at least 8 credits)			
T-MACH-105150	Constitution and Properties of Protective Coatings	4 CR	Ulrich
T-MACH-102105	Manufacturing Technology	8 CR	Schulze
T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing	4 CR	Schell
T-MACH-114100	Introduction to Microsystem Technology I	4 CR	Badilita, Korvink
T-MACH-114101	Introduction to Microsystem Technology II	4 CR	Badilita, Korvink
T-MACH-112763	Laser Material Processing	4 CR	Schneider
T-ETIT-100643	Laser Metrology	3 CR	Eichhorn
T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice	4 CR	Kärger, Liebig
T-MACH-105782	Micro Magnetic Resonannce	4 CR	Korvink, MacKinnon
T-ETIT-100676	Optical Engineering	4 CR	Stork
T-MACH-102137	Polymer Engineering I	4 CR	Liebig
T-MACH-102138	Polymer Engineering II	4 CR	Liebig
T-MACH-105971	Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures	4 CR	Kärger
T-MACH-110937	Materials Recycling and Sustainability	4 CR	Liebig
Compulsary Elective Studies PL without "X" (Election:)			
T-CIWVT-110902	Additive Manufacturing for Process Engineering - Examination	5 CR	Klahn
T-MACH-105157	Foundry Technology	4 CR	Günther, Klan
T-CIWVT-108146	Materials and Processes for Electrochemical Storage	4 CR	Tübke
T-CIWVT-110903	Practical in Additive Manufacturing for Process Engineering	1 CR	Klahn
T-MACH-108878	Laboratory Production Metrology	4 CR	Lanza, Stamer
T-MACH-110960	Project Internship Additive Manufacturing: Development and Production of an Additive Component	4 CR	Zanger
T-MACH-105170	Welding Technology	4 CR	Farajian
T-MACH-105177	Metal Forming	4 CR	Herlan
Compulsary Elective Studies SL without "X" (Election: at most 4 credits)			
T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups	4 CR	Dietrich

Competence Certificate
The success controls usually include four oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses.

Prerequisites
None

Competence Goal

The students...

- can analyze novel situations, can select manufacturing processes in a goal-oriented manner and correlated to the materials used and are able to motivate their decision.
- are capable to describe theoretically and compare process-related changes in the materials properties.
- are enabled to generate novel solutions for given problems in the field of materials processing in due consideration of scientific principles, theories and methods.
- are capable to solve problems within the field of material processing in a team-oriented manner and can act responsibly and adequately
- are able to integrate the results of others when solving given problems.
- are enabled to identify, analyze, advance systems and processes considering technical, economic and social constraints.

Content

See the different courses of the module.

Workload

The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

Learning type

Lectures, Lab Courses, Seminars

Level 4

M 4.9 Module: Properties [M-MACH-103713]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner
Organisation: KIT Department of Mechanical Engineering
Part of: Materials Science Major Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	1 term	German/English	4	3

Election notes
The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses ("exercises") are compulsory and are a prerequisite for the superordinate course in the same teaching language.

Compulsory Elective Subjects (Election: 2 items as well as 6 credits)			
T-MACH-107683	Exercises for Microstructure-Property-Relationships	2 CR	Gruber, Kirchlechner
T-MACH-107604	Microstructure-Property-Relationships	4 CR	Gruber, Kirchlechner
T-MACH-110930	Exercises for Microstructure-Property-Relationships	2 CR	Gruber, Kirchlechner
T-MACH-110931	Microstructure-Property-Relationships	4 CR	Gruber, Kirchlechner

Competence Certificate
The assessment consists of a certificate and an oral exam (about 30 minutes).

Prerequisites
None

Competence Goal
The students fundamentally understand the interrelation between the microstructure and the properties of a material. This interrelation will be elaborated for mechanical properties (elasticity, plasticity, fracture, fatigue, creep) as well as functional properties (conductivity, magnetic properties) for all material classes, respectively. The students are able to phenomenological describe the material properties, to explain the underlying physical mechanisms and to understand how the properties can be specifically modified by the microstructure of the material. In the other way they are able to deduce the mechanical and functional properties of a material on the basis of its microstructure

Content
The following microstructure-property-relationships will be discussed for all material classes:

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Electrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic properties und materials

In addition to the phenomenological description and physical explanation of the material properties an overview on the corresponding experimental techniques will be given.

Workload
The workload for the module "Properties" is 180 h per semester and consists of the presence during the lectures (33 h) and tutorials (12 h) as well as self-study for the lecture (87 h) and for the tutorials (48 h).

Learning type
Lectures (Obligatory)
Tutorials (Obligatory)

M 4.10 Module: Simulation [M-MACH-103712]

Responsible: Prof. Dr. Peter Gumbsch
Organisation: KIT Department of Mechanical Engineering
Part of: Materials Science Major Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each summer term	1 term	German/English	4	3

Election notes
The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses (“exercises“) are compulsory and are a prerequisite for the superordinate course in the same teaching language.

Compulsory Elective Subjects (Election: 2 items as well as 6 credits)			
T-MACH-107671	Exercises for Applied Materials Simulation	2 CR	Gumbsch, Schneider
T-MACH-105527	Applied Materials Simulation	4 CR	Gumbsch, Schneider
T-MACH-110928	Exercises for Applied Materials Simulation	2 CR	Gumbsch, Schneider
T-MACH-110929	Applied Materials Simulation	4 CR	Gumbsch, Schneider

Competence Certificate
The assessment consists of a certificate and an oral exam (about 30 minutes).

Prerequisites
None

Competence Goal
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
- name and discuss the possibilities and challenges of simulation approaches on different scales

Content
The modul introduces a general overview of different numerical methods and their range of application in materials science and engineering. A basic introduction to numerial methods is given and their application in different fields and scales is shown and discussed. Based on theoretical as well as practical aspects, the opportunities and challenges of numerical materials simulation is evaluated.

Workload
The workload for the modul “Simulation” is 180 h per semester and consists of the presence during the lectures (33 h) and tutorials (12 h) as well as self-study for the lecture (87 h) and for the tutorials (48 h).

Learning type
lecture, exercise

4.11 Module: Structural Materials [M-MACH-103738]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering
Part of: Focal Course I
Focal Course II

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	2 terms	German	4	15

Compulsory Elective Subjects "X" (Election: at least 8 credits)			
T-MACH-102141	Constitution and Properties of Wearresistant Materials	4 CR	Ulrich
T-MACH-114011	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	4 CR	Henning
T-MACH-113598	High Temperature Corrosion	4 CR	Gorr
T-MACH-105459	High Temperature Materials	4 CR	Heilmaier
T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	4 CR	Pundt
T-MACH-113698	Beyond Conventional Materials - Metamaterials & Architected Structures	4 CR	Bauer
T-MACH-111826	Non-ferros metals and alloys	4 CR	Heilmaier
T-MACH-102167	Nanotribology and -Mechanics	4 CR	Dienwiebel, Hölscher
T-MACH-111391	Phase Transformations in Materials	4 CR	Heilmaier, Kauffmann
T-MACH-110818	Plasticity of Metals and Intermetallics	8 CR	Heilmaier, Kauffmann
T-MACH-102157	High Performance Powder Metallurgy Materials	4 CR	Schell
T-MACH-105724	Failure Analysis	4 CR	Greiner, Schneider
T-MACH-112106	Fatigue of Materials	4 CR	Guth
T-MACH-111257	Superhard Thin Film Materials	4 CR	Ulrich
T-MACH-102103	Superhard Thin Film Materials	4 CR	Ulrich
T-MACH-105362	Technology of Steel Components	4 CR	Schulze
T-MACH-111459	Thermophysics of Advanced Materials	4 CR	Sergeev
T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	4 CR	Pundt
T-MACH-105211	Materials of Lightweight Construction	4 CR	Liebig
T-MACH-110165	Materials in Additive Manufacturing	4 CR	Dietrich, Schulze
Compulsory Elective Subjects PL without “X“ (Election:)			
T-MACH-105310	Design of Highly Stressed Components	4 CR	Aktaa
T-MACH-105330	Design with Plastics	4 CR	Liedel
T-MACH-105333	Mechanics and Strength of Polymers	4 CR	von Bernstorff
T-MACH-105516	Multi-Scale Plasticity	4 CR	Greiner, Schulz
T-MACH-114010	Vehicle Lightweight Design - Strategies, Concepts, Materials	4 CR	Henning
Compulsory Elective Subjects SL without “X“ (Election: between 0 and 4 credits)			
T-MACH-105651	Biomechanics: Design in Nature and Inspired by Nature	4 CR	Mattheck
T-MACH-105447	Metallographic Lab Class	4 CR	Heilmaier, Kauffmann
T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course	4 CR	Wagner
T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course	4 CR	Wagner
T-MACH-105178	Practical Course Technical Ceramics	4 CR	Schell

Competence Certificate
The success controls usually include four oral exams of about 25 minutes duration per exam. However, number, type and scope of the success controls can vary according to the individual choice of courses.

Prerequisites
None

Competence Goal
Students are familiar with the specific property portfolio of structural materials. They are able to assess different classes of materials against each other. Further, they are enabled to select suitable structural materials based on possible applications and parts.

Because of the great variety of selection possibilities further details may be taken out of the specific course descriptions contained in this module.

Content
Because of the great variety of selection possibilities the contents may be taken out of the specific course descriptions contained in this module.

Workload
The usual work load is:

presence time: 90 h

preparation and rework time: 390 h

The workload composite however may vary according to the individually choice of courses.

Learning type
Lectures, Lab Courses, Seminars

Level 4

M 4.12 Module: Supplementary Studies on Science, Technology and Society [M-FORUM-106753]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: Additional Examinations (Usage from 10/1/2024)

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
16	Grade to a tenth	Each term	3 terms	German	4	1

Election notes
Students have to self-record the achievements obtained in the Supplementary Studies on Science, Technology and Society in their study plan. FORUM (formerly ZAK) records the achievements as "non-assigned" under "ÜQ/SQ-Leistungen". Further instructions on self-recording of achievements can be found in the FAQ at https://campus.studium.kit.edu/ and on the FORUM homepage at https://www.forum.kit.edu/english/. The title of the examination and the amount of credits override the modules placeholders.

If you want to use FORUM achievements for both your Interdisciplinary Qualifications and for the Supplementary Studies, please record them in the Interdisciplinary Qualifications first. You can then get in contact with the FORUM study services (stg@forum.kit.edu) to also record them in your Supplementary Studies.

In the Advanced Unit you can choose examinations from three subject areas: "About Knowledge and Science", "Science in Society" and "Science in Social Debates". It is advised to complete courses from each of the three subject areas in the Advanced Unit.

To self-record achievements in the Advanced Unit, you have to select a free placeholder partial examination first. The placeholders' title do *not* affect which achievements the placeholder can be used for!

Mandatory			
T-FORUM-113578	Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
T-FORUM-113579	Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration	2 CR	Mielke, Myglas
Advanced Unit Supplementary Studies on Science, Technology and Society (Election: at least 12 credits)			
T-FORUM-113580	Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113581	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration	3 CR	Mielke, Myglas
T-FORUM-113582	Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration	3 CR	Mielke, Myglas
Mandatory			
T-FORUM-113587	Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society	0 CR	Mielke, Myglas

Competence Certificate
The monitoring is explained in the respective partial achievement.

They are composed of:
- Protocols
- Reflection reports
- Presentations
- Preparation of a project work
- An individual term paper
- An oral examination
- A written exam

Upon successful completion of the supplementary studies, graduates receive a graded report and a certificate issued by the FORUM.

Prerequisites

The course is offered during the course of study and does not have to be completed within a defined period. Enrollment is required for all assessments of the modules in the supplementary studies.
Participation in the supplementary studies is regulated by § 3 of the statutes. KIT students register for the supplementary studies by selecting this module in the student portal and booking a performance themselves. Registration for courses, assessments, and exams is regulated by § 8 of the statutes and is usually possible shortly before the start of the semester.
The course catalog, module description (module manual), statutes (study regulations), and guidelines for creating the various written performance requirements can be downloaded from the FORUM homepage at https://www.forum.kit.edu/begleitstudium-wtg.php.

Registration and exam modalities

PLEASE NOTE:

Registration on the FORUM, i.e. additionally via the module selection in the student portal, enables students to receive up-to-date information about courses or study modalities. In addition, registering on the FORUM ensures that you have proof of the credits you have earned. As it is currently (as of winter semester 24-25) not yet possible to continue additional credits acquired in the Bachelor's programme electronically in the Master's programme, we strongly advise you to digitally secure the credits you have earned by archiving the Bachelor's transcript of records yourself and by registering on FORUM.
In the event that a transcript of records of the Bachelor's certificate is no longer available - we can only assign the achievements of registered students and thus take them into account when issuing the certificate.

Competence Goal

Graduates of the Supplementary Studies on Science, Technology, and Society gain a solid foundation in understanding the interplay between science, the public, business, and politics. They develop practical skills essential for careers in media, political consulting, or research management. The program prepares them to foster innovation, influence social processes, and engage in dialogue with political and societal entities. Participants are introduced to interdisciplinary perspectives, encompassing social sciences and humanities, to enhance their understanding of science, technology, and society. The teaching objectives of this supplementary degree program include equipping participants with both subject-specific knowledge and insights from epistemological, economic, social, cultural, and psychological perspectives on scientific knowledge and its application in various sectors. Students are trained to critically assess and balance the implications of their actions at the intersection of science and society. This training prepares them for roles as students, researchers, future decision-makers, and active members of society.

Through the program, participants learn to contextualize in-depth content within broader frameworks, independently analyze and evaluate selected course materials, and communicate their findings effectively in both written and oral formats. Graduates are adept at analyzing social issues and problem areas, reflecting on them critically from a socially responsible and sustainable standpoint.

Content
The Supplementary Studies on Science, Technology and Society can be started in the 1st semester of the enrolled degree programme and is not limited in time. The wide range of courses offered by FORUM makes it possible to complete the program usually within three semesters. The supplementary studies comprises 16 or more credit points (LP). It consists of **two modules: the Basic Module (4 LP) and the Advanced Module (12 LP)**.

The **basic Module** comprises the compulsory courses 'Lecture Series Supplementary Studies on Science, Technology and Society' and a basic seminar with a total of 4 LP.

The **Advanced Module** comprises courses totalling 12 LP in the humanities and social sciences subject areas 'On Knowledge and Science', 'Science in Society' and 'Science in Public Debates'. The allocation of courses to the accompanying study programme can be found on the homepage https://www.forum.kit.edu/wtg-aktuelland in the printed FORUM course catalogue.

The 3 thematic subject areas:

Subject area 1: About Knowledge and Science

This is about the internal perspective of science: students explore the creation of knowledge, distinguishing between scientific and non-scientific statements (e.g., beliefs, pseudo-scientific claims, ideological statements), and examining the prerequisites, goals, and methods of knowledge generation. They investigate how researchers address their own biases, analyze the structure of scientific explanatory and forecasting models in various disciplines, and learn about the mechanisms of scientific quality assurance.

After completing courses in the "Knowledge and Science" area, students can critically reflect on the ideals and realities of contemporary science. They will be able to address questions such as: How robust is scientific knowledge? What are the capabilities and limitations of predictive models? How effective is quality assurance in science, and how can it be improved? What types of questions can science answer, and what questions remain beyond its scope?

Subject area 2: Science in Society

This focuses on the interactions between science and different areas of society, such as how scientific knowledge influences social decision-making and how social demands impact scientific research. Students learn about the specific functional logics of various societal sectors and, based on this understanding, estimate where conflicts of goals and actions might arise in transfer processes—for example, between science and business, science and politics, or science and journalism. Typical questions in this subject area include: How and under what conditions does an innovation emerge from a scientific discovery? How does scientific policy advice work? How do business and politics influence science, and when is this problematic? According to which criteria do journalists incorporate scientific findings into media reporting? Where does hostility towards science originate, and how can social trust in science be strengthened?

After completing courses in the "Sciene in Society" area, students can understand and assess the goals and constraints of actors in different societal sectors. This equips them to adopt various perspectives of communication and action partners in transfer processes and to act competently at various social interfaces with research in their professional lives.

Subject area 3: Science in Public Debates

The courses in this subject area provide insights into current debates on major social issues such as sustainability, digitalization, artificial intelligence, gender equality, social justice, and educational opportunities. Public debates on complex challenges are often polarized, leading to oversimplifications, defamation, or ideological thinking. This can hinder effective social solution-finding processes and alienate people from the political process and from science. Debates about sustainable development are particularly affected, as they involve a wide range of scientific and technological knowledge in both problem diagnosis (e.g., loss of biodiversity, climate change, resource consumption) and solution development (e.g., nature conservation, CCS, circular economy).

By attending courses in "Science in Public Debates," students are trained in an application-oriented way to engage in factual debates—exchanging arguments, addressing their own prejudices, and handling contradictory information. They learn that factual debates can often be conducted more deeply and with more nuance than is often seen in public discourse. This training enables them to handle specific factual issues in their professional lives independently of their own biases and to be open to differentiated, fact-rich arguments.

Supplementary credits:
Additional LP (supplementary work) totalling a maximum of 12 LP can also be acquired from the complementary study programme (see statutes for the WTG complementary study programme § 7). § 4 and § 5 of the statutes remain unaffected by this. These supplementary credits are not included in the overall grade of the accompanying study programme. At the request of the participant, the supplementary work will be included in the certificate of the accompanying study programme and marked as such. Supplementary coursework is listed with the grades provided for in § 9.

Module grade calculation
The overall grade of the supplementary course is calculated as a credit-weighted average of the grades that were achieved in the advanced module.

Annotation
Climate change, biodiversity crisis, antibiotic resistance, artificial intelligence, carbon capture and storage, and gene editing are just a few areas where science and technology can diagnose and address numerous social and global challenges. The extent to which scientific findings are considered in politics and society depends on various factors, such as public understanding and trust, perceived opportunities and risks, and ethical, social, or legal considerations.
To enable students to use their expertise as future decision-makers in solving social and global challenges, we aim to equip them with the skills to navigate the interfaces between science, business, and politics competently and reflectively. In the Supplementary Studies, they acquire foundational knowledge about the interactions between science, technology, and society.

They learn:
- How reliable scientific knowledge is produced,
- how social expectations and demands influence scientific research, and
- how scientific knowledge is adopted, discussed, and utilized by society.

The program integrates essential insights from psychology, philosophy, economics, social sciences, and cultural studies into these topics. After completing the supplementary studies programme, students can place the content of their specialized studies within a broader social context. This prepares them, as future decision-makers, to navigate competently and reflectively at the intersections between science and various sectors of society, such as politics, business, or journalism, and to contribute effectively to innovation processes, public debates, or political decision-making.

Workload
The workload is made up of the number of hours of the individual modules:

- Basic Module approx. 120 hours
- Advanced Module approx. 390 hours

\> Total: approx. 510 hours

In the form of supplementary services, up to approximately 390 hours of work can be added.

Recommendation
It is recommended to complete the supplementary study program in three or more semesters, beginning with the lecture series on science, technology, and society in the summer semester. Alternatively, you can start with the basic seminar in the winter semester and then attend the lecture series in the summer semester.

Courses in the Advanced Module can be taken simultaneously. It is also advised to complete courses from each of the three subject areas in the advanced unit.

Learning type
- Lectures
- Seminars/Project Seminars
- Workshops

M 4.13 Module: Technical Specialisation [M-MACH-103715]

Responsible: Dr. Patric Gruber
Organisation: KIT Department of Mechanical Engineering
Part of: Interdisciplinary Supplement

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
12	Grade to a tenth	Each term	2 terms	German	4	9

Compulsory Elective Subjects (Election:)			
T-MACH-105215	Applied Tribology in Industrial Product Development	4 CR	Albers, Lorentz, Matthiesen
T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery	4 CR	Düser, Ott
T-MACH-102203	Automotive Engineering I	8 CR	Gauterin, Gießler
T-MACH-106424	Rail System Technology	4 CR	Cichon
T-CHEMBIO-105199	Basic Molecular Cell Biology	2 CR	Weth
T-MACH-105184	Fuels and Lubricants for Combustion Engines	4 CR	Kehrwald, Kubach
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-105212	CAE-Workshop	4 CR	Düser
T-MACH-105694	Data Analytics for Engineers	5 CR	Meisenbacher, Mikut, Reischl
T-MACH-113405	Drive System Engineering A: Automotive Systems	4 CR	Düser, Ott
T-MACH-111807	Introduction to Bionics	4 CR	Hölscher
T-PHYS-111915	Electron Microscopy I and II, with Exercises	16 CR	Eggeler
T-MACH-105151	Energy Efficient Intralogistic Systems	4 CR	Kramer, Schönung
T-ETIT-103613	Fabrication and Characterisation of Optoelectronic Devices	3 CR	Richards
T-MACH-102166	Fabrication Processes in Microsystem Technology	4 CR	Bade
T-PHYS-103628	Fundamentals of Optics and Photonics	8 CR	Hunger
T-PHYS-103630	Fundamentals of Optics and Photonics - Unit	0 CR	Hunger
T-MACH-100092	Automotive Engineering I	8 CR	Gießler
T-MACH-105213	Fundamentals of Combustion I	4 CR	Maas
T-MACH-105325	Fundamentals of Combustion II	4 CR	Bykov, Maas
T-MACH-111389	Fundamentals in the Development of Commercial Vehicles	4 CR	Weber
T-MACH-114175	Human Factors Engineering I (Workplace Design)	4 CR	Deml
T-MACH-114176	Human Factors Engineering II (Organizational Design)	4 CR	Deml
T-ETIT-100784	Hybrid and Electric Vehicles	4 CR	Doppelbauer
T-MACH-105221	Lightweight Engineering Design	4 CR	Düser, Ott
T-MACH-103622	Measurement and Control Systems	6 CR	Stiller
T-MACH-111578	Sustainable Vehicle Drivetrains	4 CR	Koch, Toedter
T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle	4 CR	Dagan
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-105147	Product Lifecycle Management	4 CR	Ovtcharova
T-MACH-102155	Product, Process and Resource Integration in the Automotive Industry	4 CR	Mbang
T-MACH-110318	Product- and Production-Concepts for Modern Automobiles	4 CR	Kienzle, Steegmüller

T-MACH-102107	Quality Management	4 CR	Lanza
T-INFO-108014	Robotics I - Introduction to Robotics	6 CR	Asfour
T-MACH-105353	Rail Vehicle Technology	4 CR	Cichon
T-MACH-106493	Solar Thermal Energy Systems	4 CR	Dagan
T-MACH-102083	Integrated Information Systems for Engineers	4 CR	Ovtcharova
T-MACH-105290	Vibration Theory	4 CR	Fidlin
T-MACH-105363	Thermal Turbomachines I	6 CR	Bauer
T-MACH-105364	Thermal Turbomachines II	6 CR	Bauer
T-MACH-105531	Tribology	8 CR	Dienwiebel, Scherge
T-MACH-109303	Exercices - Tribology	0 CR	Dienwiebel
T-MACH-105366	Turbo Jet Engines	4 CR	Bauer
T-MACH-102170	Structural and Phase Analysis	4 CR	Wagner
T-MACH-102194	Combustion Engines I	4 CR	Koch, Kubach
T-MACH-104609	Combustion Engines II	4 CR	Koch, Kubach
T-MACH-105234	Windpower	4 CR	Lewald

Competence Certificate
The success control includes three oral exams of about 25 minutes each as standard. However, amount, type and scope of the success control can vary according to the individually choice.

Prerequisites
None

Competence Goal
The module Technical Specialisation serves the in-depth, also interdisciplinary examination of a topic of engineering sciences chosen according to one's own inclination. The students are able to explain and apply the basics of an individually chosen field of engineering science. The concrete learning objectives are given in the descriptions of the chosen courses.

Content
see title and content of the given courses.

Workload
The work load is generally:

presence time: 68 h

preparation and rework tim: 292 h

However, the composition of the work load can vary according to the individually choice.

Learning type
lectures

M 4.14 Module: Thermodynamics [M-MACH-103710]

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

Part of: Materials Science Major Course

Credits	Grading scale	Recurrence	Duration	Language	Level	Version
6	Grade to a tenth	Each term	1 term	German/English	4	4

Election notes
The module can be passed either in English or in German. The selection is set by the combined allocation of the corresponding courses in English or in German including all associated assessments. The courses in English and in German are mutually exclusive. The preparatory courses (“exercises“) are compulsory and are a prerequisite for the superordinate course in the same teaching language

Compulsory Elective Subjects (Election: 2 items as well as 6 credits)			
T-MACH-107669	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	2 CR	Seifert
T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	4 CR	Franke, Seifert
T-MACH-110924	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	2 CR	Seifert
T-MACH-110925	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	4 CR	Seifert

Competence Certificate
The assessment consists of a certificate and an oral exam (about 30 minutes).

Prerequisites
none

Competence Goal
The students know about the constitution (heterogeneous equilibria, phase diagrams) of binary, ternary and multi-component materials systems. They are able to analyze the thermodynamic properties of single and multiphase materials and their reactions with gas and liquid phases, respectively. The can apply the learned relationships to questions of production, joining, and applications of engineering materials (metallic alloy, technical ceramics, composites).

Content
1. Binary phase diagrams

2. Ternary phase diagrams

- Complete solubility
- Eutectic systems
- Peritectic systems
- Systems with transition reactions
- Systems with intermetallic phases

3. Thermodynamics of solution phases

4. Materials reactions involving pure condensed phases and a gaseous phase

5. Reaction equilibria in systems containing components in condensed solutions

6. Thermodynamics of multicomponent multiphase materials systems

7. Calculation of Phase Diagrams (CALPHAD)

Module grade calculation
- The module grade is equal to the grade of the oral exam

Annotation
The participation in Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria is obligatory.

Workload
The workload for the module “Thermodynamics” 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).

Recommendation
- Basic course in materials science and engineering
- Basic Course in mathematics
- physics or physical chemistry

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (P. Franke).

Learning type
Lectures (Obligatory)
Tutorials (Obligatory)

Literature
1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)
2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

5 Courses

T 5.1 Course: Adaptive Optics [T-ETIT-107644]

Responsible: Dr. Szymon Gladysz
Prof. Dr. Ulrich Lemmer

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each winter term	1

Events					
WT 24/25	2313724	Adaptive Optics	2 SWS	Lecture / 🗣	Gladysz
Exams					
WT 24/25	7313724	Adaptive Optics			Lemmer, Gladysz

Legend: 🖥 Online, ❄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Type of Examination: Oral examination

Duration of Examination: approx. 30 Minutes

Modality of Exam: The oral exam will be scheduled during the semester break.

The module grade is the grade of the oral exam.

Prerequisites
None.

Recommendation
Basic knowledge of statistics.

Workload
120 hours

T 5.2 Course: Additive Manufacturing for Process Engineering - Examination [T-CIWVT-110902]

Responsible: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	5	Grade to a third	Each summer term	1

Events					
ST 2025	2241020	Additive Manufacturing for Process Engineering	2 SWS	Lecture / 🗣	Klahn
Exams					
WT 24/25	7241020	Additive Manufacturing for Process Engineering - Examination			Klahn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination with a duration of about 30 minutes.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-CIWVT-110903 - Practical in Additive Manufacturing for Process Engineering must have been passed.

T 5.3 Course: Applied Materials Simulation [T-MACH-105527]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103712 - Simulation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2182614	Applied Materials Simulation	4 SWS	Lecture / Practice (/ 🖥	Gumbsch
Exams					
WT 24/25	76-T-MACH-105527	Applied Materials Modelling			Gumbsch, Schulz

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

Prerequisites
The successful participation in Übungen zu Angewandte Werkstoffsimulation is the condition for the admittance to the oral exam in Angewandte Werkstoffsimulation.

T-MACH-110928 – Exercises for Applied Materials Simulation has not been started.

T-MACH-110929 – Applied Materials Modelling has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107671 - Exercises for Applied Materials Simulation must have been passed.
2. The course T-MACH-110929 - Applied Materials Simulation must not have been started.
3. The course T-MACH-110928 - Exercises for Applied Materials Simulation must not have been started.

Workload
120 hours

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

V Applied Materials Simulation

2182614, SS 2025, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Online

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.

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

Organizational issues

Die Vorlesung wir nur als Aufzeichnung angeboten!

Bitte besuchen Sie die englischsprachige Veranstaltung "Applied Materials Simulation" (2182616)!

Weitere Informationen finden Sie in ILIAS.

Kontakt: johannes.schneider@kit.edu

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 5.4 Course: Applied Materials Simulation [T-MACH-110929]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103712 - Simulation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2182616	Applied Materials Simulation	4 SWS	Lecture / Practice (/ 🗣	Gumbsch
Exams					
WT 24/25	76-T-MACH-110929	Applied Materials Simulation			Gumbsch, Schulz

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam ca. 30 minutes

no tools or reference materials

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

T-MACH-107671 – Übungen zu Angewandte Werkstoffsimulation has not been started.

T-MACH-105527 – Angewandte Werkstoffsimulation has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110928 - Exercises for Applied Materials Simulation must have been passed.
2. The course T-MACH-105527 - Applied Materials Simulation must not have been started.
3. The course T-MACH-107671 - Exercises for Applied Materials Simulation must not have been started.

Workload
120 hours

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

V Applied Materials Simulation

Lecture / Practice (VÜ)
On-Site

2182616, SS 2025, 4 SWS, Language: English, Open in study portal

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.

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

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 5.5 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Competence Certificate
oral exam (20 min)

Prerequisites
None

Workload
120 hours

T 5.6 Course: Atomistic Simulations and Particle Dynamics [T-MACH-113412]

Responsible: Prof. Dr. Peter Gumbsch
Dr.-Ing. Johannes Schneider
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2181740	Particle Dynamics and Atomistic Simulation	3 SWS	Lecture / Practice (/ 🗣	Weygand, Gumbsch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
120 hours

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

V Particle Dynamics and Atomistic Simulation

Lecture / Practice (VÜ)
On-Site

2181740, SS 2025, 3 SWS, Language: English, Open in study portal

Content
Particle-based methods are numerical techniques used to simulate and analyse systems consisting of many discrete particles. They are particularly useful in fields where traditional continuum mechanical approaches are insufficient, such as granular materials, complex fluids, and defects in solids. In the lecture, the Discrete Element Method (DEM) for particles and Molecular Dynamics (MD) for the atomistic description of material behaviour will be covered. These methods span different length and time scales.

1. Introduction to Particle-Based Methods
   a) origin and application
   b) classification of particle-based methods
2. Fundamentals of Particle Dynamics
   a) Newtonian mechanics and conservation laws
   b) contact mechanics and friction laws
   c) kinematics and dynamics of particles
3. Discrete Element Method (DEM)
   a) principles and fundamentals
   b) numerical implementation: discretizing space and time
   c) particle detection and contact modelling
   d) application examples
4. Atomistic Methods: Molecular Dynamics (MD) and Statics (MS)
   a) fundamentals of atomistic models
   b) interaction: interatomic potentials
      i. pair potentials and their limits
      ii. many-body potentials
   c) integration methods (e.g., Verlet, Leap-Frog)
   d) periodic boundary conditions and neighbour lists
   e) applications in materials scienc
5. Structural Analysis:
   a) classification of neighbourhoods, distribution functions
   b) defect energy
   c) stresses, strains
6. Statistical Aspects of Atomistic Models
   a) phase space
   b) physical ensembles: microcanonical, canonical, grand canonical
   c) control of temperature, pressure, stresses: thermostats and barostats
   d) fluctuations and physical properties

The lecture covers both fundamental and advanced aspects of particle-based methods, with a particular focus on simple atomistic approaches. The accompanying computer exercises are designed to deepen and complement the lecture content through practical examples using the freely available particle simulation tool "LAMMPS" and to serve as a forum for detailed questions from students.

Objective: The student will be able to

- explain the physical principles of particle-based simulations,
- describe the application areas of particle-based simulation methods,
- apply particle-based simulation methods to address problems in materials science, materials engineering, and process engineering.

Recommended Prerequisites: mathematics, physics, and materials science

Lecture: 22.5 hours

Exercises: 12 hours

Self-study: 85.5 hours

Oral exam: approximately 30 minutes

Organizational issues
Die Vorlesung wird auf Englisch angeboten!

Literature

1. Understanding Molecular Simulation: From Algorithms to Applications, Daan Frenkel and Berend Smit (Academic Press, 2001) wie alle guten MD Bücher stark aus dem Bereich der physikalischen Chemie motiviert und auch aus diesem Bereich mit Anwendungsbeispielen gefüllt, trotzdem für mich das beste Buch zum Thema!
2. Computer simulation of liquids, M. P. Allen and Dominic J. Tildesley (Clarendon Press, Oxford, 1996) Immer noch der Klassiker zu klassischen MD Anwendungen. Weniger stark im Bereich der Nichtgleichgewichts-MD.
3. Computational Granular Dynamics. T. Pöschel, T. Schwager, Springer, 2005. Diskrete Element Methoden.
4. Lecture Slides and Exercises.

T 5.7 Course: Automotive Engineering I [T-MACH-100092]

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

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Expansion	Language	Version
Written examination	8	Grade to a third	Each winter term	1 terms		3

Events					
WT 24/25	2113805	Automotive Engineering I	4 SWS	Lecture / 🗣	Gießler
WT 24/25	2113809	Automotive Engineering I	4 SWS	Lecture / 🗣	Gießler
Exams					
WT 24/25	76-T-MACH-100092	Automotive Engineering			Gießler
ST 2025	76-T-MACH-100092	Automotive Engineering			Gießler

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

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.

Workload
240 hours

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

V Automotive Engineering I

2113805, WS 24/25, 4 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Learning Objectives:

The students know the movements and the forces at the vehicle and are familiar with active and passive safety. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to evaluate, and to develop the complex system "vehicle".

Organizational issues
Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Kann nicht mit der Veranstaltung [2113809] kombiniert werden.

Can not be combined with lecture [2113809].

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.: Scriptum zur Vorlesung "Grundlagen der Fahrzeugtechnik I", KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

V **Automotive Engineering I**
2113809, WS 24/25, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

Learning Objectives:

The students know the movements and the forces at the vehicle and are familiar with active and passive safety. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to evaluate, and to develop the complex system "vehicle".

Organizational issues
You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to https://fast-web-01.fast.kit.edu/PasswoerterIlias/, students from eucor universities send an e-mail to martina.kaiser@kit.edu

Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.

Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

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.: Scriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

T 5.8 Course: Automotive Engineering I [T-MACH-102203]

Responsible: Prof. Dr. Frank Gauterin
Dr.-Ing. Martin Gießler

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	1

Events					
WT 24/25	2113809	Automotive Engineering I	4 SWS	Lecture / 🗣	Gießler
Exams					
WT 24/25	76-T-MACH-102203	Automotive Engineering I			Gießler
ST 2025	76-T-MACH-102203	Automotive Engineering I			Gießler

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written examination

Duration: 120 minutes

Auxiliary means: none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-100092 - Automotive Engineering I must not have been started.

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

V Automotive Engineering I

2113809, WS 24/25, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

Learning Objectives:

The students know the movements and the forces at the vehicle and are familiar with active and passive safety. They have proper knowledge about operation of engines and alternative drives, the necessary transmission between engine and drive wheels and the power distribution. They have an overview of the components necessary for the drive and have the basic knowledge, to analyze, to evaluate, and to develop the complex system "vehicle".

Organizational issues
You will find the lecture material on ILIAS. To get the ILIAS password, KIT students refer to https://fast-web-01.fast.kit.edu/PasswoerterIlias/, students from eucor universities send an e-mail to martina.kaiser@kit.edu

Kann nicht mit LV Grundlagen der Fahrzeugtechnik I [2113805] kombiniert werden.

Can not be combined with lecture [2113805] Grundlagen der Fahrzeugtechnik I.

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.: Scriptum zur Vorlesung 'Automotive Engineering I', KIT, Institut für Fahrzeugsystemtechnik, Karlsruhe, jährlich aktualisiert

T 5.9 Course: Basic Molecular Cell Biology [T-CHEMBIO-105199]

Responsible: Dr. Franco Weth
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	2

Exams			
WT 24/25	71KSOP-105199	Basic Molecular Cell Biology	Weth

Competence Certificate
The written exam over 120 Minutes is scheduled for the beginning of the break after the SS.
A resit exam is offered at the end of the break.

Prerequisites
none

Recommendation
Basic knowledge in General Chemistry

Workload
60 hours

T 5.10 Course: Basic Seminar Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113579]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Study achievement in the form of a presentation or a term paper or project work in the selected course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that the basic seminar be completed during the same semester as the lecture series "Science in Society". If it is not possible to attend the lecture series and the basic seminar in the same semester, the basic seminar can also be attended in the semesters before the lecture series.
However, attending courses in the advanced unit before attending the basic seminar should be avoided.

Annotation

5.11 Course: Batteries and Fuel Cells [T-CHEMBIO-112316]

Responsible: Prof. Dr. Helmut Ehrenberg
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	5072	Batteries and Fuel Cells	2 SWS	Lecture / 🗣	Ehrenberg, Scheiba
Exams					
WT 24/25	7100050	Batteries and Fuel Cells			Ehrenberg

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Workload
120 hours

T 5.12 Course: Batteries and Fuel Cells [T-ETIT-100983]

Responsible: Prof. Dr.-Ing. Ulrike Krewer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each winter term	3

Events					
WT 24/25	2304207	Batteries and Fuel Cells	2 SWS	Lecture /	Krewer
WT 24/25	2304213	Batteries and Fuel Cells (Exercise to 2304207)	1 SWS	Practice /	Krewer, Sonder
Exams					
WT 24/25	7304207	Batteries and Fuel Cells			Krewer
ST 2025	7300006	Batteries and Fuel Cells			Krewer

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Prerequisites
none

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

V Batteries and Fuel Cells

2304207, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
The lecture provides a practical insight into the current application areas and research topics of fuel cells and batteries. It deals with the design and functionality of electrochemical energy conversion and storage devices and provides knowledge about materials, cell designs, measurement methods, data analysis and modelling. The lecture and most slides are in German.

Organizational issues
Veranstaltungstermine: 28.10.2024 - 10.02.2025

ILIAS Kurs

T 5.13 Course: Beyond Conventional Materials - Metamaterials & Architected Structures [T-MACH-113698]

Responsible: Jun.-Prof. Dr. Jens Bauer
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2186100	Beyond Conventional Materials - Metamaterials & Architected Structures	2 SWS	Lecture / (Blended)	Bauer
Exams					
WT 24/25	76-T-MACH-113698	Beyond Conventional Materials - Metamaterials & Architected Structures			Bauer
ST 2025	76-T-MACH-113699	Numerical Methods for Engineering Applications			Kärger

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
oral examination (approx. 30 min)

no tools or reference materials

Prerequisites
none

Workload
120 hours

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

V Beyond Conventional Materials - Metamaterials & Architected Structures

2186100, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content

Conventional material design focuses on engineering the chemistry and microstructure of solids. Metamaterials go beyond these classical approaches. They are artificial materials that are built from spatially structured building blocks, like lattice-truss architectures. The integration of these rational architectures at the material level grants metamaterials unique unconventional properties which are inaccessible with classical material designs.

The course covers the fundamentals of the mechanics of different metamaterial architectures, discusses design principles and applicable fabrication techniques from the macro- to the nanoscale, as well as their interdependency, and considers emerging application scenarios in medicine, aerospace, microsystem technology, and mobility.

The students learn

- to design beam, shell and plate-based spatial architectures, such as for extreme strength & stiffness, programmable/ adaptive behaviors and negative effective properties.
- to mathematically describe and predict the mechanical behavior of such architectural designs.
- the fundamentals of applicable fabrication techniques, including foaming, assembly and 3D-printing, and their design and material implications
- the relationship between architecture & size and how micro- and nanoscale architectures can leverage extreme physical size effects.

preliminary knowledge in mathematics, physics and materials science recommended

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam: ca. 30 minutes

no tools or reference materials

Literature

Gibson, L. J. & Ashby, M. F. Cellular Solids: Structure and properties. (Cambridge Univ. Pr., 2001).

Fleck, N. A., Deshpande, V. S. & Ashby, M. F. Micro-architectured materials: past, present and future. Proc. R. Soc. A Math. Phys. Eng. Sci. 466, 2495–2516 (2010).

Bauer, J. et al. Nanolattices: An Emerging Class of Mechanical Metamaterials. Adv. Mater. 29, 1701850 (2017).

Jiao, P., Mueller, J., Raney, J. R., Zheng, X. (Rayne) & Alavi, A. H. Mechanical metamaterials and beyond. Nat. Commun. 2023 141 14, 1–17 (2023).

T 5.14 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-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	2

Competence Certificate

Colloquium, ungraded.

Annotation

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.

Workload

120 hours

T 5.15 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2141864	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
WT 24/25	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			Guber
ST 2025	76-T-MACH-100966	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine I			Guber

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam (75 Min.)

Prerequisites
none

Workload
120 hours

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

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

2141864, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Organizational issues
BioMEMS I-Klausur: Mo, 17.03.2025, 8:00 - 10:00; 10.11 Hertz-Hörsaal (ggf. auch 10.91 Redtenbacher-Hörsaal)

BioMEMS II-Klausur: Mo, 17.02.2025, 11:00 - 13:00; 10.11 Hertz-Hörsaal

BioMEMS III-Klausur: Do, 20.02.2025, 10:00 - 12:00; 10.11 Hertz-Hörsaal

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 5.16 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2142883	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
WT 24/25	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			Guber
ST 2025	76-T-MACH-100967	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine II			Guber

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

Workload
120 hours

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

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

2142883, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Organizational issues
Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

schriftl. Prüfung: Mo, 09.09.2024, 8 - 10 Uhr; 10.21 Carl-Benz-Hörsaal

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 5.17 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2142879	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III	2 SWS	Lecture / 🗣	Guber, Ahrens
Exams					
WT 24/25	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			Guber
ST 2025	76-T-MACH-100968	BioMEMS - Microsystems Technologies for Life-Sciences and Medicine III			Guber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam (75 Min.)

Prerequisites
none

Workload
120 hours

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

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

2142879, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Organizational issues
Zu jedem Vorlesungstermin werden via ILIAS die jeweiligen Folien im PDF-Format zur Verfügung gestellt.

schriftl. Prüfung: Mo, 23.09.2024, 10:30 - 12:30 Uhr; 30.21 Christian-Gerthsen-Hörsaal

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

Responsible: Prof. Dr.-Ing. Tobias Düser
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each term	2

Events					
WT 24/25	2147175	CAE-Workshop	3 SWS	Block / 🗣	Düser
ST 2025	2147175	CAE-Workshop	3 SWS	Block / 🗣	Düser
Exams					
WT 24/25	76-T-MACH-105212	CAE-Workshop			Düser
ST 2025	76-T-MACH-105212	CAE-Workshop			Albers, Düser

Legend: 🖥 Online, ❂ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Prerequisites
None

Annotation
Consistent attendance on the workshop days is required for successful participation in the exam. The number of participants is limited. Selection will be made by drawing lots after the end of the registration period.

Workload
120 hours

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

V CAE-Workshop
2147175, WS 24/25, 3 SWS, Language: German, Open in study portal

Block (B)
On-Site

Content
Content:

- 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

The students are able to:

- name the purposes and limits of numerical simulation and optimization of the virtual product development.
- solve simple realistic tasks in the field of finite element analysis and structure optimization with industrial common software.
- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

Regular attendance: 31.5 h

Self-study: 88.5 h

Exam: 1h written

Organizational issues
Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.

Content is provided on Ilias.

V **CAE-Workshop** **Block (B) On-Site**
2147175, SS 2025, 3 SWS, Language: German, Open in study portal

Content
Content:

- 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

The students are able to:

- name the purposes and limits of numerical simulation and optimization of the virtual product development.
- solve simple realistic tasks in the field of finite element analysis, multi-body-simulation and structure optimization with industrial common software (the content in winter and summer term is different).
- evaluate and to question the results of a simulation.
- identify and improve the mistakes of a simulation or optimization.

Exam: 1h Regularly written

Regular attendance: 31.5 h

Self-study: 88.5 h

Annotation: Number of participants limited. The selection will be made by drawing after the end of the registration period.

Organizational issues
Wir empfehlen den Workshop ab dem 5. Semester.

Anmeldung erforderlich. Weitere Informationen siehe IPEK-Homepage.

Anwesenheitspflicht

Literature
Kursunterlagen werden in Ilias bereitgestellt.
Content is provided on Ilias.

5.19 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2133113	CO2-neutral combustion engines and their fuels I	3 SWS	Lecture / Practice (/	Koch
Exams					
WT 24/25	76-T-MACH-102194	CO2-neutral combustion engines and their fuels I			Kubach, Koch

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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

Prerequisites
none

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

CO2-neutral combustion engines and their fuels I

2133113, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
Introduction, Presentation of IFKM
Working Principle
Characteristic Parameters
Engine Parts
Drive Train
Fuels
Gasoline Engines
Diesel Engines
Hydrogen Engines
Exhaust Gas Emissions

Organizational issues
Übungstermine Donnerstags nach Bekanntgabe in der Vorlesung

T 5.20 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Exams			
WT 24/25	76-T-MACH-104609	Combustion Engines, Hydrogen Engines and CO2 neutral Fuels II	Kubach, Koch

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

Prerequisites
none

Recommendation
Fundamentals of Combustion Engines I helpful

T 5.21 Course: Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies [T-MACH-114011]

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

Lightweight Design
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2114053	Composite Manufacturing – Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies	2 SWS	Lecture / 🗣	Henning
Exams					
ST 2025	76-T-MACH-114011	Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies			Henning

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
written exam, duration 180 minutes

Prerequisites
T-MACH-114001 - Lightweighting Concepts and Technologies not started

T-MACH-114002 - Technologies and Simulation for Composites in Mass Production not started

Workload
120 hours

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

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

Lecture (V)
On-Site

2114053, SS 2025, 2 SWS, Language: German, Open in study portal

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

Aim of this lecture:

Students know different polymer resin materials and fiber materials and can deduce their character and use.

They understand the reinforcing effect of fibers in a matrix surrounding as well as the tasks of the single components in a compound. They know about the influence of the length of fibers, their mechanical characters and performance in a polymer matrix compound.

Student know the important industrial production processes for continuous and discontinuous reinforced polymer matrix compounds.

Literature
Literatur Leichtbau II

[1-7]

[1] M. Flemming and S. Roth, *Faserverbundbauweisen : Eigenschaften; mechanische, konstruktive, thermische, elektrische, ökologische, wirtschaftliche Aspekte*. Berlin: Springer, 2003.

[2] M. Flemming*, et al.*, *Faserverbundbauweisen : Halbzeuge und Bauweisen*. Berlin: Springer, 1996.

[3] M. Flemming*, et al.*, *Faserverbundbauweisen : Fasern und Matrices*. Berlin: Springer, 1995.

[4] M. Flemming*, et al.*, *Faserverbundbauweisen : Fertigungsverfahren mit duroplastischer Matrix*. Berlin: Springer, 1999.

[5] H. Schürmann, *Konstruieren mit Faser-Kunststoff-Verbunden : mit ... 39 Tabellen*, 2., bearb. und erw. Aufl. ed. Berlin: Springer, 2007.

[6] A. Puck, *Festigkeitsanalyse von Faser-Matrix-Laminaten : Modelle für die Praxis*. München: Hanser, 1996.

[7] M. Knops, *Analysis of failure in fibre polymer laminates : the theory of Alfred Puck*. Berlin, Heidelberg [u.a.]: Springer, 2008.

T 5.22 Course: Computational Condensed Matter Physics [T-PHYS-109895]

Responsible: Prof. Dr. Wolfgang Wenzel
Organisation: KIT Department of Physics
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	12	Grade to a third	Irregular	1 terms	1

Events					
ST 2025	4023161	Computational Condensed Matter Physics	4 SWS	Lecture / 🗣	Wenzel
ST 2025	4023162	Exercises to Computational Condensed Matter Physics	2 SWS	Practice / 🗣	Wenzel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 5.23 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-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2161250	Computational Mechanics I	2 SWS	Lecture / 🗣	Langhoff, Böhlke
Exams					
WT 24/25	76-T-MACH-105351	Computational Mechanics I			Langhoff, Böhlke

Legend: Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination, 30 min.

Prerequisites
none

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

This course is geared to MSc students of Mechanical Engineering

Workload
180 hours

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

V Computational Mechanics I

2161250, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- numerical solution of linear systems
- boundary value problems of linear elasticity
- solution methods of the boundary value problem of linear elasticity
- variational principles of linear elasticity
- finite-element-technology for linear static problems

Literature

Haupt, P.: Continuum Mechanics and Theory of Materials. Springer 2002.
W. S. Slaughter: The linearized theory of elasticity. Birkhäuser, 2002.
J. Betten: Finite Elemente für Ingenieure 2, Springer, 2004.

T 5.24 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-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2162296	Computational Mechanics II	2 SWS	Lecture / 🗣	Böhlke, Langhoff
ST 2025	2162297	Tutorial Computational Mechanics II	2 SWS	Practice / 🗣	Gisy, Hille, Böhlke, Langhoff

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination, 30 min.

Prerequisites
none

Workload
180 hours

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

V Computational Mechanics II

Lecture (V)
On-Site

2162296, SS 2025, 2 SWS, Language: German, Open in study portal

Content
overview quasistatic nonlinear phenomena; numerics of nonlinear systems; balance equations of geometrically nonlinear solid mechanics; infinitesimal plasicity; linear and gemetrically nonlinear thermoelasticity

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

V Tutorial Computational Mechanics II

Practice (Ü)
On-Site

2162297, SS 2025, 2 SWS, Language: German, Open in study portal

Content
see lecture "Computational Mechanics II"

Organizational issues
weitere Informationen in der ersten Vorlesung

Literature
siehe Vorlesung "Rechnerunterstützte Mechanik II"

T 5.25 Course: Computational Photonics, without ext. Exercises [T-PHYS-106131]

Responsible: Prof. Dr. Carsten Rockstuhl
Organisation: KIT Department of Physics
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Irregular	2

T 5.26 Course: Constitution and Properties of Protective Coatings [T-MACH-105150]

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

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2177601	Constitution and Properties of Protective Coatings	2 SWS	Lecture / 🗣	Ulrich
Exams					
WT 24/25	76-T-MACH-105150	Constitution and Properties of Protective Coatings			Ulrich
ST 2025	76-T-MACH-105150	Constitution and Properties of Protective Coatings			Ulrich

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
none

Workload
120 hours

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

V Constitution and Properties of Protective Coatings

2177601, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
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.

Recommendations: none

Organizational issues

Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 22.10.24.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 23.10.24.

Literature

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

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed

T 5.27 Course: Constitution and Properties of Wearresistant Materials [T-MACH-102141]

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

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2194643	Constitution and Properties of Wear resistant materials	2 SWS	Lecture / 🗣	Ulrich
Exams					
WT 24/25	76-T-MACH-102141	Constitution and Properties of Wearresistant Materials			Ulrich
ST 2025	76-T-MACH-102141	Constitution and Properties of Wearresistant Materials			Ulrich

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (about 30 min)

no tools or reference materials

Prerequisites
Either "Superharte Dünnschichtmaterialien“, "Superhard Thin Film Materials“ or "Constitution and Properties of Wearresistant Materials“ can be chosen within the Focal Course.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102103 - Superhard Thin Film Materials must not have been started.
2. The course T-MACH-111257 - Superhard Thin Film Materials must not have been started.

Workload
120 hours

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

V Constitution and Properties of Wear resistant materials

2194643, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
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.

Recommendations: none

Organizational issues
Die Blockveranstaltung findet in folgendem Zeitraum statt:

11.06.-13.06.2025: jeweils von 8:00-17:15 Uhr;

Ort: KIT-CN, Geb. 681, Raum 214

Anmeldung verbindlich bis zum 04.06.2025 unter sven.ulrich@kit.edu.

Nach der Anmeldung wird Ihnen im Falle einer Online-Veranstaltung der Link zur Vorlesung per E-Mail am 10.06.2025 mitgeteilt.

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

Kopien der Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed

T 5.28 Course: Data Analytics for Engineers [T-MACH-105694]

Responsible: Stefan Meisenbacher
apl. Prof. Dr. Ralf Mikut
apl. Prof. Dr. Markus Reischl

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	5	Grade to a third	Each summer term	2

Events					
ST 2025	2106014	Data Analytics for Engineers	3 SWS	Lecture / Practice (/	Mikut, Reischl, Meisenbacher
Exams					
WT 24/25	76-T-MACH-105694	Data Analytics for Engineers			Mikut

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Written exam (Duration: 1h)

Prerequisites
none

Workload
150 hours

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

V Data Analytics for Engineers

2106014, SS 2025, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)

Content
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 SciXMiner and Python): 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.

Literature

Vorlesungsunterlagen (ILIAS)

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

2008 (PDF frei im 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 SciXMiner. Techn. Ber., Forschungszentrum Karlsruhe GmbH. 2006 (Internet)

T 5.29 Course: Data Science and Scientific Workflows [T-MACH-111588]

Responsible: Prof. Dr. Peter Gumbsch
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2182741	Data Science and Scientific Workflows	3 SWS	Lecture / Practice (/ 🗣	Weygand, Gumbsch

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
written exam

Prerequisites
T-MACH-111603 must have been passed

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-111603 - Data Science and Scientific Workflows (Project) must have been passed.

Workload
90 hours

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

V Data Science and Scientific Workflows — **Lecture / Practice (VÜ) On-Site**
2182741, SS 2025, 3 SWS, Language: German, Open in study portal

Content

The amount of data generated in scientific projects is increasing rapidly. The increase is partly due to the fact that new data-based evaluation methods allow a better and more precise analysis of scientific data. In addition, the linking of data provides new insights. This requires a systematic organization of data. The necessary knowledge of data science and computer science is equally required for both computer simulations and experimental investigations. The preparation/classification (e.g. electronic laboratory notebook) and structuring of data is a necessary step for their reuse. The lecture introduces the principles and software tools for the corresponding scientific workflows: Python and libraries, Jupyter notebook, shell scripts and documentation with git-tools. Furthermore, an overview is given of database systems in materials research and the FAIR data principle (findability, accessibility, interoperability and reusability).

Objective:

Students will be able to

- organize and document data electronically
- handle data formats: simple, hierarchical ones
- deal with software management tools (git, gitlab)
- record scientific workflows in detail and ensure traceability
- use python-based libraries for data handling and analyses

Detailed lecture content:

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Automating tasks: from scripts to workflow (with many examples from simulation and experiment)
5. Data processing
6. Electronic lab book
7. Data management requirements for publicly funded projects

Exercise:

The lecture material will be deepened in the exercises (exercise 1SWS).

Mode of examination:

- Project: Project topics from the areas
    - Material simulation and workflow
    - Data organization and analysis: from experiment or simulation
    - Presentation of the project in a 15 minute lecture + questions
- Preliminary examination performance: successful start to project work

Literature
Literatur:

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O’Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O’Reilly 2016.

T 5.30 Course: Data Science and Scientific Workflows (Project) [T-MACH-111603]

Responsible: Prof. Dr. Peter Gumbsch
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Events					
ST 2025	2182741	Data Science and Scientific Workflows	3 SWS	Lecture / Practice (/ 🗣	Weygand, Gumbsch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Successfully create a functional programme/workflow and documentation.

Prerequisites
none

Workload
30 hours

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

V Data Science and Scientific Workflows

Lecture / Practice (VÜ)
On-Site

2182741, SS 2025, 3 SWS, Language: German, Open in study portal

Content
The amount of data generated in scientific projects is increasing rapidly. The increase is partly due to the fact that new data-based evaluation methods allow a better and more precise analysis of scientific data. In addition, the linking of data provides new insights. This requires a systematic organization of data. The necessary knowledge of data science and computer science is equally required for both computer simulations and experimental investigations. The preparation/classification (e.g. electronic laboratory notebook) and structuring of data is a necessary step for their reuse. The lecture introduces the principles and software tools for the corresponding scientific workflows: Python and libraries, Jupyter notebook, shell scripts and documentation with git-tools. Furthermore, an overview is given of database systems in materials research and the FAIR data principle (findability, accessibility, interoperability and reusability).

Objective:

Students will be able to

- organize and document data electronically
- handle data formats: simple, hierarchical ones
- deal with software management tools (git, gitlab)
- record scientific workflows in detail and ensure traceability
- use python-based libraries for data handling and analyses

Detailed lecture content:

1. Introduction: the need for data science and computer science basics.
2. Programming and programming paradigms using Python
3. Software and data management: local and central management (git, gitlab)
4. Automating tasks: from scripts to workflow (with many examples from simulation and experiment)
5. Data processing
6. Electronic lab book
7. Data management requirements for publicly funded projects

Exercise:

The lecture material will be deepened in the exercises (exercise 1SWS).

Mode of examination:

- Project: Project topics from the areas
  - Material simulation and workflow
  - Data organization and analysis: from experiment or simulation
  - Presentation of the project in a 15 minute lecture + questions

- Preliminary examination performance: successful start to project work

Literature
Literatur:

- Handbuch Data Science, Hanser Verlag
- Effective Computation in Physics, Scopatz & Huff, O'Reilly 2015
- Python Data Science Handbook, J. VanderPlas, O'Reilly 2016.

T 5.31 Course: Design of Highly Stressed Components [T-MACH-105310]

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

Part of: M-MACH-103738 - Structural Materials
M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2181745	Design of highly stressed components	2 SWS	Lecture / 🗣	Aktaa
Exams					
WT 24/25	76-T-MACH-105310	Design of Highly Stressed Components			Aktaa
ST 2025	76-T-MACH-105310	Design of Highly Stresses Components			Aktaa

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam ca 30 minutes

Prerequisites
none

Workload
120 hours

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

V Design of highly stressed components
2181745, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

The students know about the rules of established design codes for the assessment of components which under operation are subjected to high thermo-mechanical and/or irradiation loadings. They understnd which constitutive equations are used according to state-of-the-art of technology and research to estimate deformation and damage appearing under these loadings and to predict expected lifetime. They gained insight into the application of these generally non-linear constitutive equations in finite element codes and can judge the major issues which shall be thereby taken into account.

Qualification: Materials Sciense, solid mechanics II

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

oral exam ca. 30 minutes

Organizational issues
Die Vorlesung findet ab dem 29.10.2024 statt

Literature

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

Responsible: Dipl.-Ing. Markus Liedel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2174571	Design with Plastics	2 SWS	Block / 🗣	Liedel
Exams					
ST 2025	76-T-MACH-105330	Design with Plastics			Liedel

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Poly I

Workload
120 hours

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

V Design with Plastics
2174571, SS 2025, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

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.

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).

Organizational issues

Anmeldung unter Markus.Liedel@de.bosch.com

Literature

Materialien werden in der Vorlesung ausgegeben.
Literaturhinweise werden in der Vorlesung gegeben.

T 5.33 Course: Drive System Engineering A: Automotive Systems [T-MACH-113405]

Responsible: Prof. Dr.-Ing. Tobias Düser
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	4	Grade to a third	Each summer term	1 terms	1

Events					
ST 2025	2146231	Drive System Engineering A: Automotive Systems	3 SWS	Lecture / Practice (/ 🗣	Ott, Düser
Exams					
ST 2025	76-T-MACH-113405	Drive System Engineering A: Automotive Systems			Ott, Düser

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written examination: 90 min duration

Prerequisites
None

Workload
120 hours

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

V Drive System Engineering A: Automotive Systems

2146231, SS 2025, 3 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content
Students acquire the basic skills needed to develop future energy-efficient and at the same time comfortably drivable powertrains. This includes holistic development methods and evaluations of powertrain systems. The main topics can be divided into the following chapters:

- Powertrain System
- Driver System
- Environment System
- System Components
- Development Process

Literature
Kirchner, E.; "Leistungsübertragung in Fahrzeuggetrieben: Grundlagen der Auslegung, Entwicklung und Validierung von Fahrzeuggetrieben und deren Komponenten", Springer Verlag Berlin Heidelberg 2007

Naunheimer, H.; "Fahrzeuggetriebe: Grundlagen, Auswahl, Auslegung und Konstruktion", Springer Verlag Berlin Heidelberg 2007

5.34 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / About Knowledge and Science - Self-Registration [T-FORUM-113580]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

In the Advanced Module, students can choose their own individual focus, e.g. sustainable development, data literacy, etc. The focus should be discussed with the module coordinator at the FORUM.

5.35 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Public Debates - Self Registration [T-FORUM-113582]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 5.36 Course: Elective Specialization Supplementary Studies on Science, Technology and Society / Science in Society - Self-Registration [T-FORUM-113581]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	3	Grade to a third	Each term	1

Competence Certificate
Another type of examination assessment under § 5, section 3 involves a presentation, term paper, or project work within the chosen course.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
The contents of the basic module are helpful. The basic module should be completed or attended in parallel, but not after the advanced module.
The reading recommendations for primary and specialist literature are determined individually by the respective lecturers according to the subject area and course.

Annotation
This placeholder can be used for any achievement in the Advanced Unit of the Supplementary Studies.

T 5.37 Course: Electrical Engineering Components [T-ETIT-109292]

Responsible: Prof. Dr. Sebastian Kempf
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2312700	Electrical Engineering Components	3 SWS	Lecture / 🗣	Kempf, Lemmer
WT 24/25	2312701	Tutorial for 2312700 Electrical Engineering Components	1 SWS	Practice / 🗣	Ilin
Exams					
WT 24/25	7312700	Electrical Engineering Components			Kempf, Lemmer
ST 2025	7312700	Electrical Engineering Components			Kempf, Lemmer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
The success control is carried out in the form of a written test of 120 minutes.

Prerequisites
none

T 5.38 Course: Electromagnetics and Numerical Calculation of Fields [T-ETIT-100640]

Responsible: Prof. Dr.-Ing. Thomas Zwick
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2308263	Electromagnetics and Numerical Calculation of Fields	2 SWS	Lecture / 🗣	Pauli
WT 24/25	2308265	Exercise for 2308263 Electromagnetics and Numerical Calculation of Fields	1 SWS	Practice / 🗣	Pauli, Giroto de Oliveira
Exams					
WT 24/25	7308263	Electromagnetics and Numerical Calculation of Fields			Pauli

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Success control is carried out in the form of a written test of 120 minutes.

Prerequisites
none

Recommendation
Fundamentals of electromagnetic field theory.

T 5.39 Course: Electron Microscopy I and II, with Exercises [T-PHYS-111915]

Responsible: TT-Prof. Dr. Yolita Eggeler
Organisation: KIT Department of Physics
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	16	Grade to a third	Irregular	1

Events					
WT 24/25	4027011	Electron Microscopy I	2 SWS	Lecture / 🗣	Eggeler
WT 24/25	4027012	Exercises to Electron Microscopy I	2 SWS	Practice / 🗣	Eggeler
ST 2025	4027021	Electron Microscopy II	2 SWS	Lecture / 🗣	Eggeler
ST 2025	4027022	Exercises to Electron Microscopy II	2 SWS	Practice / 🗣	Eggeler

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral Exam, approx. 60 minutes.

Prerequisites
none

5.40 Course: Electronic Properties of Solids I, without Exercises [T-PHYS-102578]

Responsible: Prof. Dr. Matthieu Le Tacon
Prof. Dr. Wolfgang Wernsdorfer
Prof. Dr. Wulf Wulfhekel

Organisation: KIT Department of Physics

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	1

Events					
WT 24/25	4021011	Electronic Properties of Solids I	4 SWS	Lecture / 🗣	Le Tacon, Willke

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.41 Course: Electronic Properties of Solids II, without Exercises [T-PHYS-104423]

Responsible: Prof. Dr. Matthieu Le Tacon
Dr. Johannes Rotzinger
Prof. Dr. Alexey Ustinov
Prof. Dr. Wolfgang Wernsdorfer

Organisation: KIT Department of Physics

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	4021111	Electronic Properties of Solids II	2 SWS	Lecture / 🗣	Ustinov

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.42 Course: Energy Efficient Intralogistic Systems [T-MACH-105151]

Responsible: Dr.-Ing. Meike Kramer
Dr. Frank Schönung

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2117500	Energy efficient intralogistic systems	2 SWS	Lecture / 🗣	Kramer, Schönung
Exams					
WT 24/25	76-T-MACH-105151	Energy Efficient Intralogistic Systems			Kramer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral, 30 min. examination dates after the end of each lesson period.

Prerequisites
none

Recommendation
The content of course “Basics of Technical Logistics I” (T-MACH-109919) should be known.

Annotation
Visit the IFL homepage of the course for the course dates and/or possible limitations of course participation.

Workload
120 hours

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

V Energy efficient intralogistic systems

2117500, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The content of course “Basics of Technical Logistics” should be knownn.

Literature
Keine.

T 5.43 Course: Engineering Materials for the Energy Transition [T-MACH-112691]

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

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2193008	Engineering Materials for the Energy Transition	2 SWS	Lecture / 🗣	Seifert, Ziebert

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
oral exam; about 30 minutes

Prerequisites
T-MACH-108688 - The energetics of engineering materials for the energy transition must not have been started.

Recommendation
Knowledge of Materials Science.

Workload
120 hours

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

V Engineering Materials for the Energy Transition

2193008, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
oral examination (ca. 30 min)

Recommendations: Knowledge of Materials Science

Workload: 120 h

T 5.44 Course: Engineering Materials for the Energy Transition [T-MACH-109082]

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

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2193007	Engineering Materials for the Energy Transition	2 SWS	Lecture / 🗣	Seifert, Ziebert
Exams					
WT 24/25	76-T-MACH-109082	Engineering Materials for the Energy Transition			Seifert
ST 2025	76-T-MACH-109082	Engineering Materials for the Energy Transition			Seifert

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam; about 30 minutes

Prerequisites
T-MACH-108688 - The energetics of engineering materials for the energy transition must not have been started.

Recommendation
Knowledge of Materials Science.

Workload
120 hours

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

V Engineering Materials for the Energy Transition

2193007, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
oral examination (about 30 min)

Recommendations: Knowledge of Materials Science

Workload: 120 hours

T 5.45 Course: Exercices - Tribology [T-MACH-109303]

Responsible: Prof. Dr. Martin Dienwiebel
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	0	pass/fail	Each winter term	1 terms	1

Events					
WT 24/25	2181114	Tribology	5 SWS	Lecture / Practice (/ 🗣	Dienwiebel, Scherge
Exams					
WT 24/25	76-T-MACH-109303	Exercices - Tribology			Dienwiebel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
successful solving of all exercises

Prerequisites
none

Workload
20 hours

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

V Tribology
2181114, WS 24/25, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

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

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 5.46 Course: Exercises for Applied Materials Simulation [T-MACH-110928]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103712 - Simulation

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	1

Events					
ST 2025	2182616	Applied Materials Simulation	4 SWS	Lecture / Practice (/ 🗣	Gumbsch

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
successful solving of all exercises

Prerequisites
T-MACH-107671 – Übungen zu Angewandte Werkstoffsimulation has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107671 - Exercises for Applied Materials Simulation must not have been started.

Workload
60 hours

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

V Applied Materials Simulation

2182616, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

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

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 5.47 Course: Exercises for Applied Materials Simulation [T-MACH-107671]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103712 - Simulation

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	3

Events					
ST 2025	2182614	Applied Materials Simulation	4 SWS	Lecture / Practice (/ 🖥	Gumbsch

Legend: 🖥 Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
successful solving of all exercises

Prerequisites
T-MACH-110928 – Exercises for Applied Materials Simulation has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110928 - Exercises for Applied Materials Simulation must not have been started.

Workload
60 hours

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

V Applied Materials Simulation
2182614, SS 2025, 4 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Online

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.

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

Organizational issues

Die Vorlesung wir nur als Aufzeichnung angeboten!

Bitte besuchen Sie die englischsprachige Veranstaltung "Applied Materials Simulation" (2182616)!

Weitere Informationen finden Sie in ILIAS.

Kontakt: johannes.schneider@kit.edu

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 5.48 Course: Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-110924]

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

Part of: M-MACH-103710 - Thermodynamics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	1

Events					
ST 2025	2194721	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	1 SWS	Practice / 🗣	Seifert, Franke, Dürrschnabel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
successful solving of all exercises

Prerequisites
T-MACH-107669 Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must not have been started.

Workload
60 hours

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

V Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

2194721, SS 2025, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
1. Ternary phase diagrams

- Complete solubility

- Eutectic systems

2. Thermodynamics of solution phases

3. Materials reactions involving pure condensed phases and a gaseous phase

4. Reaction equilibria in systems containing components in condensed solutions

This exercise deals with the construction of isothermal sections and isopleths in ternary materials systems. The thermodynamic properties of multiphase engineering materials are calculated.

Recommendations:

- Lecture in Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria
- Basic course in materials science and engineering
- physical chemistry

regular attendance: 14 hours

self-study: 46 hours

Literature
1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)

2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T 5.49 Course: Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107669]

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

Part of: M-MACH-103710 - Thermodynamics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	4

Events					
WT 24/25	2193005	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	1 SWS	Practice / 🗣	Seifert, Ziebert, Dürrschnabel
Exams					
WT 24/25	76-T-MACH-107669	Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			Seifert

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
successful solving of all exercises

Prerequisites
T-MACH-110924 – Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110924 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must not have been started.

Workload
60 hours

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

V Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Practice (Ü)
On-Site

2193005, WS 24/25, 1 SWS, Language: German, Open in study portal

Content
1. Ternary phase diagrams

- Complete solubility

- Eutectic systems

2. Thermodynamics of solution phases

3. Materials reactions involving pure condensed phases and a gaseous phase

4. Reaction equilibria in systems containing components in condensed solutions

This exercise deals with the construction of isothermal sections and isopleths in ternary materials systems. The thermodynamic properties of multiphase engineering materials are calculated.

Recommendations:

- Lecture in Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria
- Basic course in materials science and engineering
- physical chemistry

regular attendance: 14 hours

self-study: 46 hours

Organizational issues

Die genauen Termine werden in der ersten Vorlesung (23.10.24) bekannt gegeben.

Die Übungen finden ab der zweiten Vorlesungswoche montags, 09:45-11:15 Uhr in Geb. 10.50, HS 102 statt.

Literature

1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)

2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T 5.50 Course: Exercises for Materials Characterization [T-MACH-107685]

Responsible: Dr.-Ing. Jens Gibmeier
Prof. Dr. Reinhard Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103714 - Materials Characterization

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	4

Events					
ST 2025	2174586	Materials Characterization	2 SWS	Lecture / 🗣	Gibmeier, Peterlechner
ST 2025	2174988	Tutorials and lab courses for "materials characterization"	1 SWS	Practice / 🗣	Gibmeier, Peterlechner
Exams					
ST 2025	76-T-MACH-107685	Exercises for Materials Characterization			Gibmeier

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Regular attendance

Prerequisites
T-MACH-110945 – Exercises for Materials Characterization has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110945 - Exercises for Materials Characterization must not have been started.

Workload
60 hours

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

V Materials Characterization

2174586, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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)

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**.**

Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

V Tutorials and lab courses for "materials characterization"

2174988, SS 2025, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
s. lecture "materials characterization" (V-No. 2174586)

Organizational issues

Die Termine und der Ort zu den Übungen und Laborbesuche zur Vorlesung Werkstoffanalytik (V-Nr. 2174586) werden in der Vorlesung bekanntgegeben.

The dates and locations of the tutorials and lab courses for the lecture materials characterization (V-No. 2174586) will be announced in one of the first lectures.

Literature

Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T 5.51 Course: Exercises for Materials Characterization [T-MACH-110945]

Responsible: Dr.-Ing. Jens Gibmeier
Prof. Dr. Reinhard Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103714 - Materials Characterization

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	1

Events					
WT 24/25	2173432	Tutorials and Lab Courses for "Materials Characterization"	1 SWS	Practice / 🗣	Gibmeier, Peterlechner
Exams					
WT 24/25	76-T-MACH-110945	Exercises for Materials Characterization			Gibmeier

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Regular attendance

Prerequisites
T-MACH-107685 – Übungen zu Werkstoffanalytik has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must not have been started.

Workload
60 hours

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

V Tutorials and Lab Courses for "Materials Characterization"

2173432, WS 24/25, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
s. lecture "materials characterization" (V-No. 2174586)

Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T 5.52 Course: Exercises for Microstructure-Property-Relationships [T-MACH-107683]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103713 - Properties

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	3

Events					
ST 2025	2178125	Exercices in Microstructure-Property-Relationships	1 SWS	Practice / 🗣	Kirchlechner, Wagner, Gruber
Exams					
ST 2025	76-T-MACH-107683	Exercises for Microstructure-Property-Relationships			Kirchlechner, Gruber, Wagner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Successful participation in a final colloquium

Prerequisites
T-MACH-110930 – Exercises for Microstructure-Properties-Relationships has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110930 - Exercises for Microstructure-Property-Relationships must not have been started.

Workload
60 hours

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

V Exercices in Microstructure-Property-Relationships

2178125, SS 2025, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2178124.

T 5.53 Course: Exercises for Microstructure-Property-Relationships [T-MACH-110930]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103713 - Properties

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	1

Events					
WT 24/25	2177021	Exercises in Microstructure-Property-Relationships	1 SWS	Practice / 🗣	Kirchlechner, Wagner, Gruber
Exams					
WT 24/25	76-T-MACH-110930	Exercises for Microstructure-Property-Relationships			Kirchlechner, Gruber, Wagner

Legend: 📱 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Successful participation in a final colloquium

Prerequisites
T-MACH-107683 – Übungen zu Gefüge-Eigenschafts-Beziehungen has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107683 - Exercises for Microstructure-Property-Relationships must not have been started.

Workload
60 hours

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

V Exercises in Microstructure-Property-Relationships

Practice (Ü)
On-Site

2177021, WS 24/25, 1 SWS, Language: English, Open in study portal

Content
Exercise course for the lecture Microstructure-Property-Relationships LV Nr. 2177020.

T 5.54 Course: Exercises for Solid State Reactions and Kinetics of Phase Transformations [T-MACH-110926]

Responsible: Prof. Dr.-Ing. Bronislava Gorr
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103711 - Kinetics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each summer term	1

Events					
ST 2025	2194723	Exercises for Solid State Reactions and Kinetics of Phase Transformations, Corrosion	1 SWS	Practice / 🗣	Gorr

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
successful processing of exercises

Prerequisites
T-MACH-107632 – Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion has not been started

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 not have been started.

Workload
60 hours

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

V Exercises for Solid State Reactions and Kinetics of Phase Transformations, Corrosion

2194723, SS 2025, 1 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
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

the first exercise will take place on 27.06.2024 at 11:30 - 13:00 in building 10.50 in room 602. From then on, the exercise will take place weekly and will end with a test on 22.07.2024. In order to be admitted for the oral exam, this test must be passed. Therefore, please register for the test online in the system by 17.07.2024.

regular attendance: 14 hours

self-study: 46 hours

Literature
Vorlesungsskript;

Lecture notes

T 5.55 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-103711 - Kinetics

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	2	pass/fail	Each winter term	4

Events					
WT 24/25	2193004	Exercises for Solid State Reactions and Kinetics of Phase Transformations	1 SWS	Practice / 🗣	Franke, Ziebert
Exams					
WT 24/25	76-T-MACH-107632	Exercises for Solid State Reactions and Kinetics of Phase Transformations			Seifert, Franke

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
successful processing of exercises

Prerequisites
T-MACH-110926 – Exercises for Solid State Reactions and Kinetics of Phase Transformations has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110926 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must not have been started.

Workload
60 hours

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

V Exercises for Solid State Reactions and Kinetics of Phase Transformations

2193004, WS 24/25, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
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

regular attendance: 14 hours

self-study: 46 hours

Literature
Vorlesungsskript;

Lecture notes

T 5.56 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-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	3

Events					
WT 24/25	2173560	Welding Lab Course, in groupes	3 SWS	Practical course / 🗣	Dietrich, Schulze
Exams					
WT 24/25	76-T-MACH-102099	Experimental Lab Class in Welding Technology, in Groups			Dietrich

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Lab Course Report

Annotation
The lab takes place at the beginning of the winter semester break once a year. The registration is possible during the lecture period via iam-wk-lehre@iam.kit.edu at the IAM – WK. The lab is carried out in the Handwerkskammer Karlsruhe.

You need sturdy shoes and long clothes!

Workload
120 hours

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

V Welding Lab Course, in groupes

2173560, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
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:

You need sturdy shoes and long clothes!

workload:

regular attendance: 31,5 hours
preparation: 8,5 hours
lab report: 80 hours

Organizational issues

Die Anmeldung erfolgt durch den Beitritt in den ILIAS-Kurs.

Die Lehrveranstaltung "Experimentelles schweißtechnisches Praktikum" findet dieses Jahr wieder in der Woche vom 03.-07. März 2025 statt. Der Veranstaltungsort ist die

Bildungsakademie Handwerkskammer Karlsruhe
Hertzstr. 177
76187 Karlsruhe

Die Gruppeneinteilung in die beiden Gruppen findet Anfang Februar statt!

- Gruppe 1. Montag 7.30 Uhr bis Mittwoch 12.00 Uhr
- Gruppe 2. Mittwoch 13.00 Uhr bis Freitag 15.00 Uhr

Sollte aufgrund anderer LV oder Prüfungen für Sie nur eine der beiden Gruppen in Frage kommen, melden Sie sich bitte rechtzeitig unter iam-wk-lehre@iam.kit.edu

Bitte bringen Sie festes und geschlossenes Schuhwerk (optimalerweise Arbeitsschuhe) und lange und entbehrliche Hosen sowie Oberteile mit, da wir uns die Hände schmutzig machen und mit flüssigem, umherfliegendem Metall konfrontiert sein werden. Für die Mittagspause können Sie sich selbst versorgen oder auch in der Mensa der Bildungsakademie essen.

Literature

wird im Praktikum ausgegeben

T 5.57 Course: Fabrication and Characterisation of Optoelectronic Devices [T-ETIT-103613]

Responsible: Prof. Dr. Bryce Sydney Richards
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	1

Exams			
WT 24/25	7313760	Fabrication and Characterisation of Optoelectronic Devices	Paetzold

Prerequisites
none

T 5.58 Course: Fabrication Processes in Microsystem Technology [T-MACH-102166]

Responsible: Dr. Klaus Bade
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
WT 24/25	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture / Blended	Bade
ST 2025	2143882	Fabrication Processes in Microsystem Technology	2 SWS	Lecture / On-Site	Bade
Exams					
WT 24/25	76-T-MACH-102166	Fabrication Processes in Microsystem Technology			Bade

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral examination, 20 minutes

Prerequisites
none

Workload
120 hours

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

V Fabrication Processes in Microsystem Technology
2143882, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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 5.59 Course: Failure Analysis [T-MACH-105724]

Responsible: Prof. Dr. Christian Greiner
Dr.-Ing. Johannes Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2182572	Failure Analysis	2 SWS	Lecture / 🗣	Greiner, Schneider
Exams					
WT 24/25	76-T-MACH-105724	Failure Analysis			Schneider, Greiner
ST 2025	76-T-MACH-105724	Failure Analysis			Schneider

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination, ca. 30 min

Prerequisites
none

Recommendation
basic knowledge in materials science (e.g. lecture materials science I and II)

Workload
120 hours

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

V Failure Analysis

Lecture (V)
On-Site

2182572, WS 24/25, 2 SWS, Language: German, Open in study portal

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

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

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 5.60 Course: Fatigue of Materials [T-MACH-112106]

Responsible: Dr.-Ing. Stefan Guth
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2173586	Fatigue of Materials	2 SWS	Lecture / 🗣	Guth
Exams					
WT 24/25	76-T-MACH-112106	Fatigue of Materials			Guth
ST 2025	76-T-MACH-112106	Fatigue of Materials			Guth

Legend: 🖥 Online, 🔄 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 20 minutes

Prerequisites
none

Recommendation
Basic knowledge in Materials Science will be helpful.

Workload
120 hours

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

V Fatigue of Materials

2173586, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Introduction: historical review and some fatigue damage cases
- Cyclic Stress Strain Behaviour
- Crack Initiation
- Crack Propagation
- Lifetime Behaviour under Cyclic Loading
- Fatigue of Notched Components
- Structural Durability
- Fatigue of composites and compound materials

learning objectives:

The students are able to recognise the deformation and the failure behaviour of 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 evaluate the cyclic strength behaviour of materials and components both qualitatively and quantitatively and know the procedures for the assessment of single-stage, multistage and stochastic cyclical loadings.

requirements:

none, basic knowledge in Material Science will be helpful

workload:

regular attendance: 21 hours
self-study: 99 hours

Literature
Ein Manuskript, das auch aktuelle Literaturhinweise enthällt, wird in der Vorlesung verteilt.

T 5.61 Course: Foundations of Nonlinear Continuum Mechanics [T-MACH-105324]

Responsible: apl. Prof. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2181720	Foundations of nonlinear continuum mechanics	2 SWS	Lecture / 🗣	Kamlah
Exams					
WT 24/25	76-T-MACH-105324	Foundations of Nonlinear Continuum Mechanics			Kamlah
ST 2025	76-T-MACH-105324	Foundations of Nonlinear Continuum Mechanics			Kamlah

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam

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

V Foundations of nonlinear continuum mechanics

2181720, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

The students understand the fundamental structure of a continuum theory consisting of kinematics, balance laws and constitutive model. In particular, they recognize non-linear continuum mechanics as a common structure including all continuum theories of thermomechanics, which are obtained by adding a corresponding constitutive model. The students understand in detail the kinematics of finite deformation and know the transition to the geometrically linear theory they are familiar with. The students know the spatial and material representation of the theory and the different related tensors. The students take the balance laws as physical postulates and understand their respective physical motivation.

Qualification: Engineering Mechanics - Advanced Mathematics

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

oral exam ca. 30 minutes

Literature
Vorlesungsskript

T 5.62 Course: Foundry Technology [T-MACH-105157]

Responsible: Dr.-Ing. Daniel Günther
Dr.-Ing. Steffen Klan

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2174575	Foundry Technology	2 SWS	Lecture / 🗣	Klan, Günther

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is carried out as a written exam of about 1 h.

Prerequisites
none

Recommendation
The lectures Materials Science I and Materials Science II should have been attended in advance.

Workload
120 hours

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

V Foundry Technology

2174575, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
Literaturhinweise werden in der Vorlesung gegeben

Reference to literature, documentation and partial lecture notes given in lecture

T 5.63 Course: Fracture and Damage Mechanics [T-BGU-100087]

Responsible: Prof. Dr.-Ing. Thomas Seelig
Organisation: KIT Department of Civil Engineering, Geo and Environmental Sciences
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	6	Grade to a third	Each term	1 terms	1

Events					
WT 24/25	6215903	Fracture and Damage Mechanics	2 SWS	Lecture / 🗣	Seelig
WT 24/25	6215904	Exercises Fracture and Damage Mechanics	2 SWS	Practice / 🗣	Mitarbeiter/innen, Seelig
Exams					
WT 24/25	8243100087	Fracture and Damage Mechanics			Seelig

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, appr. 45 min.

Prerequisites
none

Recommendation
none

Annotation
none

Workload
180 hours

T 5.64 Course: Fuels and Lubricants for Combustion Engines [T-MACH-105184]

Responsible: Hon.-Prof. Dr. Bernhard Ulrich Kehrwald
Dr.-Ing. Heiko Kubach

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2133108	Fuels and Lubricants for Combustion Engines	2 SWS	Lecture / 🗣	Kehrwald
Exams					
WT 24/25	76-T-MACH-105184	Fuels and Lubricants for Combustion Engines			Kehrwald

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

2133108, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
electric drives and fuel cell drives with the associated operating materials will also be presented

- Introduction, basics, primary energy and energy chains
- Illustrative chemistry of hydrocarbons
- Fossil fuels, exploration, processing, standards
- Operating materials not fossil, renewable, alternative
- Fuels, lubricants, coolants, AdBlue
- Laboratory analysis, testing, test benches and measurement technology
- Excursion to test fields for motorized drives from 0.5 to 3,500 kW

Literature
Skript

T 5.65 Course: Functional Ceramics [T-MACH-105179]

Responsible: Dr. Miriam Botros
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2126784	Functional Ceramics	2 SWS	Lecture / Blended	Botros
Exams					
WT 24/25	76T-MACH-105179	Functional Ceramics			Botros, Hinterstein
ST 2025	76-T-MACH-105179	Functional Ceramics			Botros, Hinterstein

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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 5.66 Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-107670]

Responsible: Dr. Peter Franke
Prof. Dr. Hans Jürgen Seifert

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103710 - Thermodynamics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	4

Events					
WT 24/25	2193002	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	2 SWS	Lecture / 🗣	Seifert, Dürrschnabel
Exams					
WT 24/25	76-T-MACH-107670	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			Seifert

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte is the condition for the admittance to the oral exam in Thermodynamische Grundlagen / Heterogene Gleichgewicht.

T-MACH-110924 – Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started.

T-MACH-110925 – Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must have been passed.
2. The course T-MACH-110925 - Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must not have been started.
3. The course T-MACH-110924 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must not have been started.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

Workload
120 hours

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

V Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria

Lecture (V)
On-Site

2193002, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
Oral examination (about 30 min)

Teaching Content:

1. Binary phase diagrams

2. Ternary phase diagrams

- Complete solubility
- Eutectic systems
- Peritectic systems
- Systems with transition reactions
- Systems with intermetallic phases

3. Thermodynamics of solution phases

4. Materials reactions involving pure condensed phases and a gaseous phase

5. Reaction equilibria in systems containing components in condensed solutions

6. Thermodynamics of multicomponent multiphase materials systems

7. Calculation of Phase Diagrams (CALPHAD)

Recommendations:

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (Franke); basic course in materials science and Engineering; basic course in mathematics; physics or physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students know the heterogeneous phase equilibria of binary, ternary and multicomponent materials systems. They can analyze the thermodynamic properties of multiphase engineering materials and their reactions with gas and liquid phases.

Literature
1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)

2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T 5.67 Course: Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria [T-MACH-110925]

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

Part of: M-MACH-103710 - Thermodynamics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2194720	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria	2 SWS	Lecture / 🗣	Seifert, Franke, Dürrschnabel
Exams					
WT 24/25	76-T-MACH-110925	Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria			Seifert

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria is the condition for the admittance to the oral exam in Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria.

T-MACH-107669 – Übungen zu Thermodynamische Grundlagen / Heterogene Gleichgewichte has not been started.

T-MACH-107670 – Thermodynamische Grundlagen / Heterogene Gleichgewichte has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107670 - Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must not have been started.
2. The course T-MACH-110924 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must have been passed.
3. The course T-MACH-107669 - Exercises for Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria must not have been started.

Recommendation
Basic course in materials science and engineering

Basic course in mathematics

physics or physical chemistry

Workload
120 hours

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

V Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria — **Lecture (V) On-Site**
2194720, SS 2025, 2 SWS, Language: English, Open in study portal

Content
Oral examination (about 30 min)

Teaching Content:

1. Binary phase diagrams

2. Ternary phase diagrams

- Complete solubility
- Eutectic systems
- Peritectic systems
- Systems with transition reactions
- Systems with intermetallic phases

3. Thermodynamics of solution phases

4. Materials reactions involving pure condensed phases and a gaseous phase

5. Reaction equilibria in systems containing components in condensed solutions

6. Thermodynamics of multicomponent multiphase materials systems

7. Calculation of Phase Diagrams (CALPHAD)

Recommendations:

Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (Gorr); basic course in materials science and Engineering; basic course in mathematics; physics or physical chemistry

regular attendance: 22 hours

self-study: 98 hours

The students know the heterogeneous phase equilibria of binary, ternary and multicomponent materials systems. They can analyze the thermodynamic properties of multiphase engineering materials and their reactions with gas and liquid phases.

Literature
1. Phase Equilibria, Phase Diagrams and Phase Transformations, Their Thermodynamic Basis; M. Hillert, University Press, Cambridge (2007)

2. Introduction to the Thermodynamics of Materials; D.R. Gaskell, Taylor & Francis (2008)

T 5.68 Course: Fundamentals in the Development of Commercial Vehicles [T-MACH-111389]

Responsible: Christof Weber
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	see Annotations	2 terms	2

Events					
WT 24/25	2113812	Fundamentals in the Development of Commercial Vehicles I	1 SWS	Lecture / 🗣	Weber
ST 2025	2114844	Fundamentals in the Development of Commercial Vehicles II	1 SWS	Lecture / 🗣	Weber
Exams					
WT 24/25	76T-MACH-111389	Fundamentals in the Development of Commercial Vehicles			Weber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral group examination

Duration: appr. 30 minutes

Auxiliary means: none

Prerequisites
none

Annotation
Fundamentals in the Development of Commercial Vehicles I, WT

Fundamentals in the Development of Commercial Vehicles II, ST

Workload
120 hours

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

V Fundamentals in the Development of Commercial Vehicles I

Lecture (V)
On-Site

2113812, WS 24/25, 1 SWS, Language: German, Open in study portal

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

Learning Objectives:

The students have proper knowledge about the process of commercial vehicle development starting from the concept and the underlying original idea to the real design. They know that the customer requirements, the technical realisability, the functionality and the economy are important drivers.

The students are able to develop parts and components. Furthermore they have knowledge about different cab concepts, the interior and the interior design process. Consequently they are ready to analyze and to judge concepts of commercial vehicles as well as to participate competently in the commercial vehicle development.

Organizational issues

Das Vorlesungsmaterial wird auf ILIAS bereitgestellt. Das ILIAS-Passwort erhalten Sie unter https://fast-web-01.fast.kit.edu/PasswoerterIlias/

Termine und Nähere Informationen: siehe ILIAS oder Institutshomepage

Dates and further information will be published on the homepage of the institute.

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.

V **Fundamentals in the Development of Commercial Vehicles II**
2114844, SS 2025, 1 SWS, Language: German, Open in study portal
Lecture (V)
On-Site

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

Learning Objectives:

The students know the advantages and disadvantages of different drives. Furthermore they are familiar with components, such as transfer box, propeller shaft, powered and non-powered frontaxle etc. Beside other mechanical components, such as chassis, axle suspension and braking system, also electric and electronic systems are known. Consequently the student are able to analyze and to judge the general concepts as well as to adjust them precisely with the area of application.

Organizational issues

Genaue Termine sowie nähere Informationen und eventuelle Terminänderungen:

siehe Institutshomepage.

Literature

1.HILGERS, M.: Nutzfahrzeugtechnik lernen, Springer Vieweg, ISSN: 2510-1803

2.SCHITTLER, M.; HEINRICH, R.; KERSCHBAUM, W.: Mercedes-Benz Baureihe 500 – neue V-Motorengeneration für schwere Nutzfahrzeuge, MTZ 57 Nr. 9, S. 460 ff, 1996

3.Robert Bosch GmbH (Hrsg.): Bremsanalgen für Kraftfahrzeuge, VDI-Verlag, Düsseldorf, 1. Auflage, 1994

4.RUBI, V.; STRIFLER, P. (Hrsg. Institut für Kraftfahrwesen RWTH Aachen): Indiustrielle Nutzfahrzeugentwicklung, Schriftenreihe Automobiltechnik, 1993

5.TEUTSCH, R.; CHERUTI, R.; GASSER, R.; PEREIRA, M.; de SOUZA, A.; WEBER, C.: Fuel Efficiency Optimization of Market Specific Truck Applications, Proceedings of the 5th Commercial Vehicle Technology Symposium – CVT 2018

T 5.69 Course: Fundamentals of Combustion I [T-MACH-105213]

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

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2165515	Fundamentals of Combustion I	2 SWS	Lecture / 🗣	Maas, Shrotriya
WT 24/25	2165517	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 🗣	Bykov
WT 24/25	3165016	Fundamentals of Combustion I	2 SWS	Lecture / 🗣	Maas
WT 24/25	3165017	Fundamentals of Combustion I (Tutorial)	1 SWS	Practice / 🗣	Bykov
Exams					
WT 24/25	76-T-MACH-105213	Fundamentals of Combustion I - german exam			Maas
WT 24/25	76-T-MACH-105464	Fundamentals of Combustion I - english exam			Maas
ST 2025	76-T-MACH-105213	Fundamentals of Combustion I			Maas
ST 2025	76-T-MACH-105464	Fundamentals of Combustion I			Maas

Legend: 🖥 Online, ⚭ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam, approx. 3 hours

Prerequisites
T-MACH-114043 and T-MACH-113998 must not have started

Workload
120 hours

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

V Fundamentals of Combustion I

2165515, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

Organizational issues
Bei zu wenigen Hörern wird die Lehrveranstaltung mit der englischen Lehrveranstaltung zusammengelegt.

Literature
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V	**Fundamentals of Combustion I (Tutorial)** 2165517, WS 24/25, 1 SWS, Language: German, Open in study portal	**Practice (Ü)** **On-Site**

Literature

- Vorlesungsskript
- J. Warnatz; U. Maas; R.W. Dibble: Verbrennung, Springer, Heidelberg 1996

V	**Fundamentals of Combustion I** 3165016, WS 24/25, 2 SWS, Language: English, Open in study portal	**Lecture (V)** **On-Site**

Content

- Fundamental concepts and phenomena
- Experimental analysis of flames
- Conservation equations for laminar flat flames
- Chemical reactions
- Chemical kinetics mechanisms
- Laminar premixed flames
- Laminar diffusion flames
- Ignition processes
- NOx formation
- Formation of hydrocarbons and soot

Literature
Vorlesungsskript,

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

T 5.70 Course: Fundamentals of Combustion II [T-MACH-105325]

Responsible: Dr. Viatcheslav Bykov
Prof. Dr. Ulrich Maas

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	4

Events					
ST 2025	2166538	Fundamentals of combustion II	2 SWS	Lecture / 🗣	Maas
ST 2025	2166539	Übung zu Grundlagen der technischen Verbrennung II	1 SWS	Practice / 🗣	Maas
ST 2025	3166550	Fundamentals of Combustion II	2 SWS	Lecture / 🗣	Maas, Shrotriya, Bykov
Exams					
ST 2025	76-T-MACH-105325	Fundamentals of Combustion II			Maas

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, approx. 20 min

Prerequisites
T-MACH-114044 and T-MACH-113998 must not have started

Workload
120 hours

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

V Fundamentals of combustion II

2166538, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Turbulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

Literature
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

V Übung zu Grundlagen der technischen Verbrennung II

2166539, SS 2025, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
Calculation and Simulation of combustion processes

Literature
Skript Grundlagen der technischen Verbrennung (I+II) von Prof. Dr. rer. nat. habil. U. Maas
Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch, Heidelberg 1996

V

Fundamentals of Combustion II

3166550, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- Three dimensional Navier-Stokes equations for reacting flows
- Tubulent reactive flows
- Turbulent non-premixed flames
- Turbulent premixed flames
- Combustion of liquid and solid fuels
- Engine knock
- Thermodynamics of combustion processes
- Transport phenomena
- Effects of Combustion Processes on the Atmosphere

Organizational issues
Time and location will be announced on the website and at the institute showcase.

Literature
Vorlesungsskript;

Buch Verbrennung - Physikalisch-Chemische Grundlagen, Modellbildung, Schadstoffentstehung, Autoren: U. Maas, J. Warnatz, R.W. Dibble, Springer-Lehrbuch; Heidelberg, Karlsruhe, Berkley 2006

T 5.71 Course: Fundamentals of Optics and Photonics [T-PHYS-103628]

Responsible: Prof. Dr. David Hunger
Organisation: KIT Department of Physics
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	1

Events					
WT 24/25	4044021	KSOP - Fundamentals of Optics & Photonics	4 SWS	Lecture / 🗣	Kreysing, Lemmer
WT 24/25	4044022	KSOP - Exercises to Fundamentals of Optics & Photonics	2 SWS	Practice / 🗣	Hunger, Palkhivala, Kreysing
Exams					
WT 24/25	7800058	Fundamentals of Optics and Photonics - Exam 1			Hunger, Lemmer, Kreysing

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
Successfull participation in the exercises

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-PHYS-103630 - Fundamentals of Optics and Photonics - Unit must have been passed.

T 5.72 Course: Fundamentals of Optics and Photonics - Unit [T-PHYS-103630]

Responsible: Prof. Dr. David Hunger
Organisation: KIT Department of Physics
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Version
Completed coursework	0	pass/fail	1

Events					
WT 24/25	4044021	KSOP - Fundamentals of Optics & Photonics	4 SWS	Lecture / 🗣	Kreysing, Lemmer
WT 24/25	4044022	KSOP - Exercises to Fundamentals of Optics & Photonics	2 SWS	Practice / 🗣	Hunger, Palkhivala, Kreysing
Exams					
WT 24/25	7800057	Fundamentals of Optics & Photonics - Exercises			Hunger, Kreysing, Lemmer

Legend: 📱 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.73 Course: Fundamentals on Plasma Technology [T-ETIT-100770]

Responsible: Dr.-Ing. Rainer Kling
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2313734	Fundamentals on Plasma Technology	2 SWS	Lecture / ✕	Kling
Exams					
WT 24/25	7313734	Fundamentals on Plasma Technology			Kling, Trampert

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Prerequisites
none

T 5.74 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-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2183721	High Performance Computing	2 SWS	Lecture / Practice (/ ✕	Nestler, Selzer

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

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

Workload
150 hours

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

V High Performance Computing

2183721, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Cancelled

Content
PLEASE NOTE: This lecture is only offered in the winter semester!

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.

Organizational issues
Dieser Kurs findet im Wintersemester 2024/2025 nicht statt.

Literature

1. Vorlesungsskript; Übungsaufgabenblätter; Programmgerüste
2. Parallele Programmierung, Thomas Rauber, Gudula Rügner; Springer 2007

T 5.75 Course: High Performance Powder Metallurgy Materials [T-MACH-102157]

Responsible: apl. Prof. Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2126749	Advanced powder metals	2 SWS	Lecture / 🗘	Schell
Exams					
WT 24/25	76-T-MACH-102157	High Performance Powder Metallurgy Materials			Schell, Wagner
ST 2025	76-T-MACH-102157	High Performance Powder Metallurgy Materials			Schell

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
oral exam, 20- 30 min

Prerequisites
none

Workload
120 hours

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

V Advanced powder metals

2126749, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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 5.76 Course: High Temperature Corrosion [T-MACH-113598]

Responsible: Prof. Dr.-Ing. Bronislava Gorr
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2193055	High Temperature Corrosion	2 SWS	Lecture / 🗣	Gorr
Exams					
WT 24/25	76-T-MACH-113598	High Temperature Corrosion			Gorr

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 30 minutes)

Prerequisites
none

Recommendation
Knowledge from the basic materials science lecture

Workload
120 hours

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

V High Temperature Corrosion

2193055, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Oral examination (about 30 min)

Teaching content:

- High temperature functional and structural materials
- Thermodynamic fundamentals
- Kinetics and oxidation rate laws
- Defects in oxides
- Carl Wagner oxidation theory
- Oxidation of alloys
- Internal corrosion
- Protective coatings

Qualification targets:

The students gain fundamental understanding about underlying oxidation mechanisms of pure metals and complex alloys and acquire knowledge about ways to intrinsically protect high temperature materials by changing their chemical composition or/and atmospheric conditions as well as by applying protective coatings.

Recommendations:

Basic course in materials science and engineering and the course *Introduction to high temperature materials* (Gorr)

Organizational issues
Anmeldung verbindlich bis zum 18.10.2024 unter sabine.deubig@kit.edu und bronislava.gorr@kit.edu

Literature

- Birks, N., Meier, G.H. and Pettit, F.S., Introduction to the High Temperature Oxidaiton of Metals, Cambridge University Press, (Cambridge, 2006)
- Kofstad, P., High Temperature Corrosion, Elsevier Applied Science, (London, 1988)

T 5.77 Course: High Temperature Materials [T-MACH-105459]

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

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2174605	High Temperature Materials	2 SWS	Lecture / 🗣	Heilmaier
Exams					
WT 24/25	76-T-MACH-105459	High Temperature Materials			Heilmaier
ST 2025	76-T-MACH-105459	High Temperature Materials			Heilmaier

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Workload
120 hours

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

V High Temperature Materials

2174605, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- 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

Literature
B. Ilschner, Hochtemperaturplastizität, Springer-Verlag, Berlin

M.E. Kassner, Fundamentals of Creep in Metals and Alloys, Elsevier, Amsterdam, 2009

T 5.78 Course: Human Factors Engineering I (Workplace Design) [T-MACH-114175]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2109031	Human Factors Engineering I (Workplace Design	2 SWS	Lecture / 🗣	Deml
Exams					
WT 24/25	76-T-MACH-114175	Human Factors Engineering I (Workplace Design)			Deml

Legend: 🖥 Online, ❃ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written exam, duration 60 minutes

Prerequisites
none

Workload
120 hours

T 5.79 Course: Human Factors Engineering II (Organizational Design) [T-MACH-114176]

Responsible: Prof. Dr.-Ing. Barbara Deml
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2109032	Human Factors Engineering II (Organizational Design)	2 SWS	Lecture / 🗣	Deml
Exams					
WT 24/25	76-T-MACH-114176	Human Factors Engineering II (Organizational Design)			Deml

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
written exam, 60 minutes

Prerequisites
none

Workload
120 hours

5.80 Course: Hybrid and Electric Vehicles [T-ETIT-100784]

Responsible: Prof. Dr. Martin Doppelbauer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2306321	Hybrid and Electric Vehicles	2 SWS	Lecture / 🔀	Doppelbauer
WT 24/25	2306323	Tutorial for 2306323 Hybrid and Electric Vehicles	1 SWS	Practice / 🔀	Doppelbauer
Exams					
WT 24/25	7306321	Hybrid and Electric Vehicles			Doppelbauer
ST 2025	7306321	Hybrid and Electric Vehicles			Doppelbauer

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.81 Course: Hydrogen as Energy Carrier [T-CHEMBIO-112317]

Responsible: Prof. Dr. Helmut Ehrenberg
Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	1

Exams			
WT 24/25	7100039	Hydrogen as Energy Carrier	Ehrenberg

Competence Certificate
Oral exam, about 25 minutes

Workload
120 hours

T 5.82 Course: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112159]

Responsible: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each summer term	1 terms	2

Events					
ST 2025	2173584	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / 🗣	Wagner
Exams					
ST 2025	76-T-MACH-112159	Hydrogen in Materials – Exercises and Lab Course			Wagner

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Regular participation and participating in lab course, protocol included.

Prerequisites
none

Workload
120 hours

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

V Hydrogen in Materials – Exercises and Lab Course

2173584, SS 2025, 2 SWS, Language: English, Open in study portal

Practice (Ü)
On-Site

Content
In this exercise with lab course the contents of the lecture "Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement" are deepened. The students know the differences in thermodynamics and kinetics of the hydrogen interaction with storage materials and construction materials. The students can describe the hydrogen interaction with microstructural defects in materials, and they know the resulting effects on the materials' mechanical integrity. Based on this, the students can express the requirements of the respective materials classes and transfer them to engineering applications.

Utilizing proper experimental setups, the students can measure hydrogen induced stresses in materials as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

T 5.83 Course: Hydrogen in Materials – Exercises and Lab Course [T-MACH-112942]

Responsible: Dr. rer. nat. Stefan Wagner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	4	pass/fail	Each winter term	1 terms	1

Events					
WT 24/25	2174573	Hydrogen in Materials – Exercises and Lab Course	2 SWS	Practice / 🗣	Wagner
Exams					
WT 24/25	76-T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course			Wagner
ST 2025	76-T-MACH-112942	Hydrogen in Materials – Exercises and Lab Course			Wagner

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Regular participation and participating in lab course, protocol included.

Prerequisites
none

Workload
120 hours

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

V Hydrogen in Materials – Exercises and Lab Course
2174573, WS 24/25, 2 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
In this exercise with lab course the contents of the lecture “Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement” are deepened. The students know the differences in thermodynamics and kinetics of the hydrogen interaction with storage materials and construction materials. The students can describe the hydrogen interaction with microstructural defects in materials, and they know the resulting effects on the materials’ mechanical integrity. Based on this, the students can express the requirements of the respective materials classes and transfer them to engineering applications.

Utilizing proper experimental setups, the students can measure hydrogen induced stresses in materials as well as the hydrogens' diffusivity and its chemical potential. From the measurement data, the students can construct metal-hydrogen phase diagrams, and they can qualitatively assess the defect density in the metal.

T 5.84 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110957]

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2174572	Hydrogen in Materials: from energy storage to hydrogen embrittlement	2 SWS	Lecture / 🗣	Pundt, Wagner
Exams					
WT 24/25	76-T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt
ST 2025	76-T-MACH-110957	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-110923 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

T-MACH-108853 - Wasserstoff in Materialien has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110923 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Annotation
in German

Workload
120 hours

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

V Hydrogen in Materials: from energy storage to hydrogen embrittlement
2174572, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

This lecture teaches physical and chemical basics of hydrogen adsorption and absorption of different materials. It trains the understanding of the specific lattice positions that hydrogen occupies within solids, and its impact on material properties. A thermodynamical approach yields Sievert's law, allowing the students to describe the different solubilities of hydrogen (and other gases) in solid materials. Further thermodynamic data can be obtained using van't Hoff plots of phase transformation pressures. The impact of ternary alloy components, as described by semi-empirical models, will be recognized. The specific mobility of hydrogen in materials will be understood, which divides into classical diffusion and quantum mechanical tunneling processes. The students can describe the interaction of hydrogen with defects in crystal lattices, which is of special interest for properties of nano-scale materials or for the hydrogen embrittlement of steels. Basic embrittlement models can be explained by the students. Actual hydrogen storage systems can be summarized.

learning objectives:

o Hydrogen as energy storage – the hydrogen cycle and safety issues

o methods for hydrogen charging of materials and hydrogen detection

o Hydrogen adsorption at and absorption in different solids, Sievert's law

o interstitial lattice sites and lattice expansion

o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams

o ternary alloy effects

o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling

o interaction of hydrogen with defects

o hydrogen embrittlement of steels, different embrittlement models

o hydrogen in nano-scale systems and new storage materials

Organizational issues

Teilnahme nach Anmeldung.

Literature

Literaturhinweise und Unterlagen in der Vorlesung

T 5.85 Course: Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement [T-MACH-110923]

Responsible: Prof. Dr. Astrid Pundt
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2173588	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement	2 SWS	Lecture / 🗣	Pundt, Wagner
Exams					
WT 24/25	76-T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt
ST 2025	76-T-MACH-110923	Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement			Pundt

Legend: 📱 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-108853 - Wasserstoff in Materialien has not been started

T-MACH-110957 - Wasserstoff in Materialien: von der Energiespeicherung zur Materialversprödung has not been started

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110957 - Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement must not have been started.

Annotation
in English

Workload
120 hours

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

V Hydrogen in Materials: from Energy Storage to Hydrogen Embrittlement — **Lecture (V) On-Site**
2173588, SS 2025, 2 SWS, Language: English, Open in study portal

Content

This lecture teaches physical and chemical basics of hydrogen adsorption and absorption of different materials. It trains the understanding of the specific lattice positions that hydrogen occupies within solids, and its impact on material properties. A thermodynamical approach yields Sievert's law, allowing the students to describe the different solubilities of hydrogen (and other gases) in solid materials. Further thermodynamic data can be obtained using van't Hoff plots of phase transformation pressures. The impact of ternary alloy components, as described by semi-empirical models, will be recognized. The specific mobility of hydrogen in materials will be understood, which divides into classical diffusion and quantum mechanical tunneling processes. The students can describe the interaction of hydrogen with defects in crystal lattices, which is of special interest for properties of nano-scale materials or for the hydrogen embrittlement of steels. Basic embrittlement models can be explained by the students. Actual hydrogen storage systems can be summarized.

learning objectives:

o Hydrogen as energy storage – the hydrogen cycle and safety issues

o methods for hydrogen charging of materials and hydrogen detection

o Hydrogen adsorption at and absorption in different solids, Sievert's law

o interstitial lattice sites and lattice expansion

o Hydrides, van't Hoff plots, phase transitions, M-H binary phase diagrams

o ternary alloy effects

o hydrogen mobility in materials: interstitial diffusion and quantum mechanical tunneling

o interaction of hydrogen with defects

o hydrogen embrittlement of steels, different embrittlement models

o hydrogen in nano-scale systems and new storage materials

Literature

Literaturhinweise und Unterlagen in der Vorlesung

T 5.86 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
WT 24/25	2121001	Integrated Information Systems for engineers	3 SWS	Lecture / Practice (/ 🗣	Elstermann
Exams					
WT 24/25	76-T-MACH-102083	Integrated Information Systems for Engineers			Ovtcharova, Elstermann

Legend: 🖥 Online, ✣ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Workload
120 hours

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

V Integrated Information Systems for engineers

2121001, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

- Information systems, information management
- CAD, CAP and CAM systems
- PPS, ERP and PDM systems
- Knowledge management and ontology
- Process modeling

Students can:

- illustrate the structure and operating mode of information systems
- describe the structure of relational databases
- describe the fundamentals of knowledge management and its application in engineering and deploy ontology as knowledge representation
- describe different types of process modelling and their application and illustrate and execute simple work flows and processes with selected tools
- explain different goals of specific IT systems in product development (CAD, CAP, CAM, PPS, ERP, PDM) and assign product development processes

Organizational issues
Blockveranstaltung vom 07. - 10. Oktober

Literature
Vorlesungsfolien / lecture slides

T 5.87 Course: Internship [T-MACH-107764]

Responsible: Dr. Patric Gruber
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103838 - Internship

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	12	pass/fail	Each term	2

Exams			
WT 24/25	76-T-MACH-107764	Internship	Gruber
ST 2025	76-T-MACH-107764	Internship	Gruber

Competence Certificate
Presentation of the internship documents (training contract, activity report, internship certificate) as well as placement of an internship report in the form of a short oral presentation (about 10 min) and a written report.

Prerequisites
none

Annotation
As part of the master's program, an internship must be completed in accordance with SPO § 14a. The compulsory minimum duration is 9 weeks. Missed working hours must be made up in any case. In the case of time off, the trainee should ask the training company for a contract extension in order to be able to get the work experience to the required extent.

The internship office does not convey internships. The students have to contact a company and ask for a suitable internship. The internship relationship becomes legally binding through the training contract to be concluded between the company and the trainee. The contract defines all rights and obligations of the trainee and the training company as well as the type and duration of the work experience. The term “company” is synonymous here with engineering firms, enterprises, authorities etc. However, the internship cannot be completed at a KIT facility.

Workload
360 hours

T 5.88 Course: Introduction to Bionics [T-MACH-111807]

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

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2142151	Introduction to Biomimetics	2 SWS	Lecture / 🗣	Hölscher, Greiner
Exams					
WT 24/25	76-T-MACH-102172	Introduction into Biomimetics			Hölscher

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam (duration: 60 minutes)

Prerequisites
none

Annotation
Brick T-MACH-102172 may not be started

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

V Introduction to Biomimetics

2142151, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

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

Basic knowledge in physics and chemistry

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

Organizational issues
Im ILIAS werden Materialien (Videos, Originalliteratur, Übungen) zur Vertiefung zur Verfügung gestellt.

Für die schriftliche Klausur werden zwei Termine angeboten (erste Woche nach Vorlesungsende im Sommersemester und eine Woche vor Vorlesungsbeginn im Wintersemester).

Literature
Folien und Literatur werden in ILIAS zur Verfügung gestellt.

T 5.89 Course: Introduction to Microsystem Technology I [T-MACH-114100]

Responsible: Dr. Vlad Badilita
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2141861	Introduction to Microsystem Technology I	2 SWS	Lecture / 🗣	Korvink, Badilita

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written examination (60 min)

Prerequisites
T-MACH-114035 and T-MACH-105182 must not have started

Workload
120 hours

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

V Introduction to Microsystem Technology I

2141861, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Literature
Mikrosystemtechnik für Ingenieure, W. Menz und J. Mohr, VCH Verlagsgesellschaft, Weinheim 2005

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

T 5.90 Course: Introduction to Microsystem Technology II [T-MACH-114101]

Responsible: Dr. Vlad Badilita
Prof. Dr. Jan Gerrit Korvink

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2142874	Introduction to Microsystem Technology II	2 SWS	Lecture / 🗣	Korvink, Badilita

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written examination (60 min)

Prerequisites
T-MACH-114035 and T-MACH-105183 must not have started

Workload
120 hours

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

V Introduction to Microsystem Technology II

2142874, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
- Introduction in Nano- and Microtechnologies
- Lithography
- LIGA-technique
- Mechanical microfabrication
- Patterning with lasers
- Assembly and packaging
- Microsystems

Organizational issues
Topic: Grundlagen der Mikrosystemtechnik II (MST II) SS 21
Time: Thursdays 14:00 - 15:30

10.91 Redtenbacher-Hörsaal

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

5.91 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-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Written examination	3	Grade to a third	Each summer term	4

Events					
ST 2025	2162282	Introduction to the Finite Element Method	2 SWS	Lecture / 🗣	Langhoff, Böhlke

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam (90 min)

prerequisites: passing the corresponding "Tutorial to Introduction to the Finite element method" (T-MACH-110330)

Prerequisites
Passing the "Tutorial to 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

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.
If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

Workload
90 hours

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

V Introduction to the Finite Element Method

2162282, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

- 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

Literature

- Fish, J., Belytschko, T.: A First Course in Finite Elements, Wiley 2007
- Jung, M., Langer, U.: Methode der finiten Elemente für Ingenieure: Eine Einführung in die numerischen Grundlagen und Computersimulation, Teubner 2013
- Braess, D.: Finite Elemente -- Theorie, schnelle Löser und Anwendungen in der Elastizitätstheorie, Springer 2013
- Gustafsson, B.: Fundamentals of Scientific Computing, Springer 2011

T 5.92 Course: Introduction to Theory of Materials [T-MACH-105321]

Responsible: apl. Prof. Marc Kamlah
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2182732	Introduction to Theory of Materials	2 SWS	Lecture / 🗣	Kamlah
Exams					
WT 24/25	76-T-MACH-105321	Introduction to Theory of Materials			Kamlah
ST 2025	76-T-MACH-105321	Introduction to Theory of Materials			Kamlah

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam

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

V Introduction to Theory of Materials

2182732, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

The student can judge for a problem to be computed, which constitutive model should be selected depending on choice of material and loading. For computation tools such as commercial finite element codes, the students can understand the documentation with respect to the implemented constitutive models, and they can make their choice based on their knowledge. The students have basic knowledge for the development of constitutive laws.

Qualification: Engineering Mechanics; Advanced Mathematics

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

oral exam ca. 30 minutes

Literature
[1] Peter Haupt: Continuum Mechanics and Theory of Materials, Springer
[2] Skript

T 5.93 Course: Laboratory Production Metrology [T-MACH-108878]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Dr. Florian Stamer

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each summer term	3

Events					
ST 2025	2150550	Laboratory Production Metrology	3 SWS	Practical course / 🗣	Lanza, Stamer

Legend: 🖥 Online, ✿ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Alternative Test Achievement: Group presentation of 15 min at the beginning of each experiment and evaluation of the participation during the experiments

and

Oral Exam (15 min)

Prerequisites
none

Annotation
For organizational reasons the number of participants for the course is limited. Hence al selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Workload
120 hours

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

V Laboratory Production Metrology

Practical course (P)
On-Site

2150550, SS 2025, 3 SWS, Language: German, Open in study portal

Content
During this course, students get to know measurement systems that are used in a production system. In the age of Industry 4.0, sensors are becoming more important. Therefore, the application of in-line measurement technology such as machine vision and non-destructive testing is focussed. Additionally, laboratory based measurement technologies such as computed tomography are addressed. The students learn the theoretical background as well as practical applications for industrial examples. The students use sensors by themselves during the course. Additionally, they are trained on how to integrate sensors in production processes and how to analyze measurement data with suitable software.

The following topics are addressed:

- Classification and examples for different measurement technologies in a production environment
- Machine vision with optical sensors
- Information fusion based on optical measurements
- Robot-based optical measurements
- Non-destructive testing by means of acoustic measurements
- Coodinate measurement technology
- Industrial computed tomography
- Measurement uncertainty evaluation
- Analysis of production data by means of data mining

Learning Outcomes:

The students …

- are able to name, describe and mark out different measurement technologies that are relevant in a production environment.
- are able to conduct measurements with the presented in-line and laboratory based measurement systems.
- are able to analyze measurement results and asses the measurement uncertainty of these.
- are able to deduce whether a work piece fulfills quality relevant specifications by analysing measurement results.
- are able to use the presented measurement technologies for a new task.

Workload:

regular attendance: 31,5 hours
self-study: 88,5 hours

Organizational issues
Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Die Bewerbung erfolgt über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

For organizational reasons the number of participants for the course is limited. Hence a selection process will take place. Applications are made via the homepage of wbk (http://www.wbk.kit.edu/studium-und-lehre.php).

Literature
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt. Ebenso wird auf gängie Fachliteratur verwiesen.

Lecture notes will be provided in Ilias (https://ilias.studium.kit.edu/). Additional reference to literature will be provided, as well.

T 5.94 Course: Laser Material Processing [T-MACH-112763]

Responsible: Dr.-Ing. Johannes Schneider
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2182642	Laser Material Processing	2 SWS	Lecture / 🗣	Schneider
Exams					
WT 24/25	76-T-MACH-112763	Laser Material Processing			Schneider

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (30 min)

no tools or reference materials

Prerequisites
It is not possible, to combine this brick with Laser in Automotive Engineering [T-MACH-105164], brick Physical Basics of Laser Technology [T-MACH-109084] and brick Physical Basics of Laser Technology [T-MACH-102102].

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
120 hours

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

V Laser Material Processing

2182642, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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 material processing
- 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

Organizational issues
Die Vorlesung ersetzt die bisherige Vorlesung "Lasereinsatz im Automobilbau" und wird jetzt auf Englisch angeboten!

The lecture replaces the previous lecture "Laser Application in Automotive Engineering" and is now offered in English!

Literature
W. T. Silvast: Laser Fundamentals, 2004, Cambridge University Press

J. Eichler, H.-J. Eichler: Laser - Basics, Advances, Applications, 2018, Springer

P. Poprawe: Tailored Light 1, 2018, Springer

K. F. Renk: Basics of Laser Physics, 2017, Springer

M. W. Sigrist: Laser: Theorie, Typen und Anwendungen, 2018, Springer-Spektrum

H. Hügel, T. Graf: Materialbearbeitung mit Laser, 2022, Springer Vieweg

T. Graf: Laser - Grundlagen der Laserstrahlquellen, 2009, Vieweg-Teubner Verlag

R. Poprawe: Lasertechnik für die Fertigung, 2005, Springer

T 5.95 Course: Laser Metrology [T-ETIT-100643]

Responsible: Prof. Dr. Marc Eichhorn
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2303200	Laser Metrology	2 SWS	Lecture / 🗣	Eichhorn
Exams					
WT 24/25	7303200	Laser Metrology			Eichhorn

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The exam will be taken as an oral examination (about 20 minutes). The individual appointments for examination are offered at two previously determined dates.

Prerequisites
none

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

V Laser Metrology
2303200, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Current time schedule can be found in ILIAS

Organizational issues
Beginn am Do. 24. April 2025, 9:45 - 13:15

Seminarraum IRS, Raum 119 Geb. 30.33.

Weitere Details werden in ILIAS bekannt gegeben. Prüfungen werden ebenfalls über ILIAS organisiert

Starting on Thursday, 24th April, 9:45 - 13:15

Room 119, Building 30.33

Further details are annouced in ILIAS. Exam registration will also be organised via ILIAS.

T 5.96 Course: Laser-Assisted Methods and Their Application for Energy Storage Materials [T-MACH-106739]

Responsible: Prof. Wilhelm Pfleging
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	2

Events					
WT 24/25	2193013	Laser-assisted methods and their application for energy storage materials	2 SWS	Lecture / 🗣	Pfleging
ST 2025	2193013	Laser-assisted methods and their application for energy storage materials	2 SWS	Lecture / Blended	Pfleging
Exams					
WT 24/25	76-T-MACH-106739	Laser-assisted methods and their application for energy storage materials			Pfleging

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 30 min)

Prerequisites
none

Recommendation
Fundamentals of solid state physics and optics

Workload
120 hours

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

V Laser-assisted methods and their application for energy storage materials

Lecture (V)
On-Site

2193013, WS 24/25, 2 SWS, Language: English, Open in study portal

Content
Registration via ILIAS or by e-mail to: pfleging@kit.edu

consulting-hour: Wednesdays after the lecture, 4 - 5 p.m.; Campus South, building 10.50, room 603.2

Oral Examination: ca. 30 min

Teaching Content:

- Optics and beam shaping
- Laser-induced plasma
- Thermal-assisted laser materials processing
- Functionalization of surfaces
- Self-organized processes
- Fundamental aspects of battery technology
- Laser processes in battery manufacturing
- Advanced concepts for high energy and high power batteries
- Laser-based post-mortem analytics

Recommendations: Basics of Solid State Physics and Optics

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

Laser technology is a cutting-edge field with a wide range of applications. This course covers innovative laser processes, including cutting, welding, and structuring, at the micro and nanometer scale. It also discusses different laser beam sources and their integration into battery production. The students are equipped with comprehensive tools to independently evaluate, design, and optimize a process. The laser group at KIT is the only one that provides such extensive training on the use of state-of-the-art beam sources in battery production in an application-oriented manner.

Organizational issues
You will receive the lecture material and further information via ILIAS

Literature

- Laser in der Fertigung, Grundlagen der Strahlquellen, Systeme, Fertigungsverfahren, Autoren: Hügel, Helmut, Graf, Thomas, ISBN 978-3-8348-1817-1, Springer Verlag, 2014
- Laser Processing and Chemistry, Autor: Bäuerle, Dieter W., ISBN 978-3-642-17613-5, Springer, 2011
- Handbuch Lithium-Ionen-Batterien, Korthauer, Reiner (Hrsg.), ISBN 978-3-642-30653-2, Springer Verlag, 2013
- Lithium-ion Battery Materials and Engineering, Autoren: Malgorzata K. Gulbinska, ISBN 978-1-4471-6548-4, Springer Verlag, 2014
- Laser-Induced Breakdown Spectroscopy, Theory and Applications, Autoren: Sergio Musazzi, Umberto Perini, Springer Series in Optical Sciences, ISBN 978-3-642-45084-6, 2007

V **Laser-assisted methods and their application for energy storage materials**
2193013, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
Oral Examination: ca. 30 min

Teaching Content:

- Optics and beam shaping
- Laser-induced plasma
- Thermal-assisted laser materials processing
- Functionalization of surfaces
- Self-organized processes
- Fundamental aspects of battery technology
- Laser processes in battery manufacturing
- Advanced concepts for high energy and high power batteries
- Laser-based post-mortem analytics

Recommendations: Basics of Solid State Physics and Optics

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

The students will get an in-depth insight into the various aspects of modern laser technology and laser beam-material interactions. They will get knowledge about the use of laser radiation for functionalization of modern energy storage materials for batteries. They get used handling of scientific methods for describing the physical processes which is communicated in an application-oriented manner.

Organizational issues
The lecture will take place in building 30.28, room R220
The lecture can possibly take place online. Find out more on ILIAS.
Register if possible by April 14, 2025 by email to pfleging@kit.edu or via ILIAS.

Literature

- Laser in der Fertigung, Grundlagen der Strahlquellen, Systeme, Fertigungsverfahren, Autoren: Hügel, Helmut, Graf, Thomas, ISBN 978-3-8348-1817-1, Springer Verlag, 2014
- Laser Processing and Chemistry, Autor: Bäuerle, Dieter W., ISBN 978-3-642-17613-5, Springer, 2011
- Handbuch Lithium-Ionen-Batterien, Korthauer, Reiner (Hrsg.), ISBN 978-3-642-30653-2, Springer Verlag, 2013
- Lithium-ion Battery Materials and Engineering, Autoren: Malgorzata K. Gulbinska, ISBN 978-1-4471-6548-4, Springer Verlag, 2014
- Laser-Induced Breakdown Spectroscopy, Theory and Applications, Autoren: Sergio Musazzi, Umberto Perini, Springer Series in Optical Sciences, ISBN 978-3-642-45084-6, 2007

T 5.97 Course: Lecture Series Supplementary Studies on Science, Technology and Society - Self Registration [T-FORUM-113578]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	1

Competence Certificate
Active participation, learning protocols, if applicable.

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)
- FORUM (ehem. ZAK) Begleitstudium

Recommendation
It is recommended that you complete the lecture series "Science in Society" before attending events in the advanced module and in parallel with attending the basic seminar.
If it is not possible to attend the lecture series and the basic seminar in the same semester, the lecture series can also be attended after attending the basic seminar.
However, attending events in the advanced module before attending the lecture series should be avoided.

Annotation
The basic module consists of the lecture series "Science in Society" and the basic seminar. The lecture series is only offered during the summer semester.
The basic seminar can be attended in the summer or winter semester.

T 5.98 Course: Light and Display Engineering [T-ETIT-100644]

Responsible: Dr.-Ing. Rainer Kling
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2313747	Light and Display Engineering	2 SWS	Lecture / ✕	Kling
WT 24/25	2313749	Übungen zu 2313747 Light and Display Engineering	1 SWS	Practice / ✕	Kling
Exams					
WT 24/25	7313747	Light and Display Engineering			Kling

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Prerequisites
none

T 5.99 Course: Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice [T-MACH-110954]

Responsible: Prof. Dr.-Ing. Luise Kärger
Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2113110	Lightweight constructions with fiber-reinforced-polymers – theory and practice	4 SWS	Lecture / Practice (/ 🗣	Kärger, Liebig
Exams					
WT 24/25	76-T-MACH-110954	Lightweight constructions with fiber-reinforced-polymers – theory and practice			Liebig, Kärger
ST 2025	76-T-MACH-110954	Lightweight Constructions with Fiber-Reinforced-Polymers – Theory and Practice			Liebig, Kärger

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 minutes)

Prerequisites
T-MACH-114005 - Calculation, production and testing of fiber composite components - theory and practice must not be started.

Recommendation

- Materials of Lightweight Construction
- Structural Analysis of Composite Laminates
- Composite Manufacturing - Polymers, Fibers, Semi-Finished Products, Manufacturing Technologies

Workload
120 hours

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

V Lightweight constructions with fiber-reinforced-polymers – theory and practice

Lecture / Practice (VÜ)
On-Site

2113110, WS 24/25, 4 SWS, Language: German, Open in study portal

Content

The cooperative educational concept of the FAST-LB and IAM-WK give students an understanding of theory and practice for lightweight constructing with fiber-reinforced-polymers. Students solve an engineering lightweight task in small groups (max. 4 p.), for example the construction of an optimal bending beam under certain space and weight conditions. Various Materials (fibers, resins, foams, etc.) as well as relevant material data are provided and can be used any arbitrary combination. Mechanical properties of the semi-finished fiber products are to be determined by supervised tests on coupon samples. In a first step, students develop a theoretical solution and verify it simulative. Therefore, an introductory basic lecture teaches the mechanics and simulations techniques of fiber-reinforced-polymers. In a second step the students manufacture specimens based on their theoretical solution at the IAM-WK. The specimens are then tested on bending machines. The students gain knowledge about fiber-reinforced-polymers (materials, manufacturing, manufacturing effects, restrictions, etc.) and structural analysis simulations (modelling, simplifications, assumptions, material models, etc.) as well as material characterization and testing. Building on the basic lecture the knowledge is gained autonomously by solving realistic practice relevant tasks. The main topics are

- Fundamentals of lightweight strategies
- Basics of fiber-reinforced-polymers
- Basics of FEM simulation with anisotropic multi-material systems
- Independent development of suitable component concepts in teams of 4
- Independent development of simulation models for verification and design of own component concepts
- Calculation of anisotropic stiffness parameters from characterization tests
- Manufacturing of fiber-reinforced-polymers
- Mechanical testing

Learning Objectives

Students will be able to name and explain lightweight design strategies. They are familiar with typical fiber and matrix materials and their function in fiber composite materials. They will be familiar with the operating principle of a sandwich composite with foam core and will be able to describe and justify typical deformation and stress curves. They can name characteristic mechanical parameters and manufacturing processes. For the numerical analysis of FRP components, the students know simple laminate theories, they can set up a finite element model in Abaqus, select suitable finite elements, evaluate the simulation results and derive conclusions for improving the load-bearing effect. Students know the main steps and boundary conditions for manual fabrication and mechanical testing of fiber composite sandwich structures and can apply them in practice. They learn to work independently in teams on an open task, to elaborate the necessary boundary conditions and parameters and to obtain additional information where necessary.

T 5.100 Course: Lightweight Engineering Design [T-MACH-105221]

Responsible: Prof. Dr.-Ing. Tobias Düser
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2146190	Lightweight Engineering Design	2 SWS	Lecture / 🗣	Ott
Exams					
WT 24/25	76-T-MACH-105221	Lightweight Engineering Design			Albers, Burkardt
ST 2025	76-T-MACH-105221	Lightweight Engineering Design			Ott, Düser, Albers

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Written examination (90 min)

Prerequisites
None

Workload
120 hours

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

V Lightweight Engineering Design

2146190, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
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.

Organizational issues
Vorlesungsfolien können über die eLearning-Plattform ILIAS bezogen werden.

Die Prüfungsart wird gemäß der Prüfungsordnung zu Vorlesungsbeginn angekündigt:

- Schriftliche Prüfung: 90 min Prüfungsdauer
- Mündliche Prüfung: 20 min Prüfungsdauer
- Erlaubte Hilfsmittel: keine

Medien: Beamer

Arbeitsbelastung:

- Präsenzzeit: 21 h
- Selbststudium: 99 h

Lecture slides are available via eLearning-Platform ILIAS.

The type of examination (written or oral) will be announced at the beginning of the lecture:

- written examination: 90 min duration
- oral examination: 20 min duration
- auxiliary means: None

Media: Beamer

Workload:

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

Literature
Klein, B.: Leichtbau-Konstruktion. Vieweg & Sohn Verlag, 2007

Wiedemann, J.: Leichtbau: Elemente und Konstruktion, Springer Verlag, 2006

Harzheim, L.: Strukturoptimierung. Grundlagen und Anwendungen. Verlag Harri Deutsch, 2008

T 5.101 Course: Manufacturing Technology [T-MACH-102105]

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

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Written examination	8	Grade to a third	Each winter term	3

Events					
WT 24/25	2149657	Manufacturing Technology	6 SWS	Lecture / Practice (/	Schulze
Exams					
WT 24/25	76-T-MACH-102105	Manufacturing Technology			Schulze

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Written Exam (180 min)

Prerequisites
none

Workload
240 hours

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

V Manufacturing Technology
2149657, WS 24/25, 6 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
Blended (On-Site/Online)

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.

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

Organizational issues
Vorlesungstermine montags und dienstags, Übungstermine mittwochs.
Bekanntgabe der konkreten Übungstermine erfolgt in der ersten Vorlesung.

Die LV wird letztmalig im WS 2024/25 angeboten (Vorlesungsvideos bleiben online).

Die Prüfung wird für Erstschreiber letztmalig im SS 2025 und Wiederholer letztmalig im WS 2025/26 angeboten.

Literature
Medien:
Skript zur Veranstaltung wird über ilias (https://ilias.studium.kit.edu/) bereitgestellt.

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

T 5.102 Course: Master's Thesis [T-MACH-107759]

Responsible:	Prof. Dr.-Ing. Martin Heilmaier
Organisation:	KIT Department of Mechanical Engineering
Part of:	M-MACH-103835 - Master's Thesis

Type	Credits	Grading scale	Recurrence	Version
Final Thesis	30	Grade to a third	Each term	2

Competence Certificate
The master thesis is designed to show that the student is able to deal with a problem of his/her subject area in an independent manner and within the given period of time using scientific methods.
The maximal processing time of the master thesis takes three months. With consent of the examiner the thesis can be written in another language than German as well. The date of issue of the subject has to be fixed by the supervisor and the student and to be put on record at the examination board. The subject of the master thesis may be only returned once and only within the first month of processing time.
On a reasoned request of the student, the examination board can extend the processing time by up to one month. If the master thesis is not completed in time, this examination is "failed" (5,0), unless the student is not responsible.
The bachelor thesis is to be evaluated by not less than a professor or a senior scientist according to § 14 Abs. 3 Ziff. 1 KITG or habilitated members of the KIT Department of Mechanical Engineering and another examiner. Generally, one of the two examiners is the person who has assigned the thesis.
If the examiners do not agree, the master thesis is graded by the examination board within this assessment; another expert can be appointed too. The master thesis has to be graded within a period of six weeks after the submission.

Prerequisites
The requirement for admission to the master thesis module are 75 ECTS. As to exceptions, the examination board decides on a request of the student (see § 14 (1) SPO).

Modeled Conditions
The following conditions have to be fulfilled:

1. You need to have earned at least 75 credits in the following fields:
    - Internship
    - Interdisciplinary Supplement
    - Materials Science Major Course
    - Focal Course I
    - Focal Course II
    - Interdisciplinary Qualifications

Final Thesis
This course represents a final thesis. The following periods have been supplied:

Submission deadline	6 months
Maximum extension period	1 months
Correction period	6 weeks

Workload
900 hours

T 5.103 Course: Materials and Processes for Electrochemical Storage [T-CIWVT-108146]

Responsible: Prof. Dr. Jens Tübke
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
ST 2025	2245840	Materials and Processes for Electrochemical Storage	2 SWS	Lecture / 🗣	Tübke
Exams					
WT 24/25	7291840	Materials for Electrochemical Storage			Tübke
ST 2025	7245840	Materials and Processes for Electrochemical Storage			Tübke

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
None

T 5.104 Course: Materials Characterization [T-MACH-107684]

Responsible: Dr.-Ing. Jens Gibmeier
Prof. Dr. Reinhard Schneider

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103714 - Materials Characterization

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	4

Events					
ST 2025	2174586	Materials Characterization	2 SWS	Lecture / 🗣	Gibmeier, Peterlechner
Exams					
WT 24/25	76-T-MACH-107684	Materials Characterization			Gibmeier
ST 2025	76-T-MACH-107684	Materials Characterization			Gibmeier

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
Successful participation in Übungen zu Werkstoffanalytik is the condition for the admittance to the oral exam in Werkstoffanalytik.

T-MACH-110945 – Exercises for Materials Characterization has not been started.

T-MACH-110946 – Materials Characterization has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107685 - Exercises for Materials Characterization must have been passed.
2. The course T-MACH-110945 - Exercises for Materials Characterization must not have been started.
3. The course T-MACH-110946 - Materials Characterization must not have been started.

Workload
120 hours

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

V Materials Characterization

2174586, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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)

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.

Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T 5.105 Course: Materials Characterization [T-MACH-110946]

Responsible: Dr.-Ing. Jens Gibmeier
Prof. Dr. Reinhard Schneider
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103714 - Materials Characterization

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2173431	Materials Characterization	2 SWS	Lecture / 🗣	Gibmeier, Peterlechner
Exams					
WT 24/25	76-T-MACH-110946	Materials Characterization			Gibmeier
ST 2025	76-T-MACH-110946	Materials Characterization			Gibmeier

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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.

T-MACH-107685 – Übungen zu Werkstoffanalytik has not been started.

T-MACH-107684 – Werkstoffanalytik has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110945 - Exercises for Materials Characterization must have been passed.
2. The course T-MACH-107685 - Exercises for Materials Characterization must not have been started.
3. The course T-MACH-107684 - Materials Characterization must not have been started.

Workload
120 hours

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

V Materials Characterization

2173431, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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)

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.

Organizational issues
Start am 22.10.2024

Literature
Vorlesungsskript (wird zu Beginn der Veranstaltung ausgegeben).

Literatur wird zu Beginn der Veranstaltung bekanntgegeben.

T 5.106 Course: Materials in Additive Manufacturing [T-MACH-110165]

Responsible: Dr.-Ing. Stefan Dietrich
Prof. Dr.-Ing. Volker Schulze

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2173600	Materials in Additive Manufacturing	2 SWS	Lecture / 🗣	Dietrich
Exams					
WT 24/25	76-T-MACH-110165	Materials in Additive Manufacturing			Dietrich
ST 2025	76-T-MACH-110165	Materials in Additive Manufacturing			Dietrich

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, about 25 minutes

Prerequisites
none

Workload
120 hours

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

V Materials in Additive Manufacturing

2173600, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
learning objectives:

requirements:
none

workload:

T 5.107 Course: Materials Modelling: Dislocation Based Plasticity [T-MACH-105369]

Responsible: Dr. Daniel Weygand
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2182740	Materials modelling: dislocation based plasticity	2 SWS	Lecture / 🗣	Weygand
Exams					
WT 24/25	76-T-MACH-105369	Materials Modelling: Dislocation Based Plasticity			Weygand

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
120 hours

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

V Materials modelling: dislocation based plasticity

2182740, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

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 5.108 Course: Materials of Lightweight Construction [T-MACH-105211]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2174574	Materials of Lightweight Construction	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-105211	Materials of Lightweight Construction			Liebig
ST 2025	76-T-MACH-105211	Materials of Lightweight Construction			Liebig

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-114012 must not have been started.

Recommendation
Materials Science I/II

Workload
120 hours

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

V Materials of Lightweight Construction

2174574, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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).

Examination:

Oral examination, Duration approx. 25 min

Literature

Literaturhinweise, Unterlagen und Teilmanuskript in der Vorlesung

5.109 Course: Materials Recycling and Sustainability [T-MACH-110937]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2173520	Materials Recycling and Sustainability	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-110937	Materials Recycling and Sustainability			Liebig

Legend: 📱 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 min.)

Prerequisites
T-MACH-114012 must not have been started.

Workload
120 hours

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

V Materials Recycling and Sustainability

2173520, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The lecture series is organised in two main topics: On the one hand, fundamentals of sustainability are explained and it is shown how to tread more sustainable paths in materials science and mechanical engineering. On the other hand, separation and recycling processes for all common classes of materials are presented and discussed. It is shown how recycling fosters a holistic and sustainable perspective on material processing and use.

1. legal bases and historical background
2. climate change, ecology and material flows
3. sustainability in general
4. product responsibility, recyclable design and planned obsolescence
5. general and legal bases of recycling
6. material separation, sorting and processing
7. recycling of metals
8. recycling of polymers and composites
9. recycling of everyday materials
10. alternative materials and alternative design concepts
11. materials for renewable energy sources

Literature
Skript wird in der Vorlesung ausgegeben

T 5.110 Course: Mathematical Methods in Micromechanics [T-MACH-110378]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	5	Grade to a third	Each summer term	1 terms	2

Events					
ST 2025	2162280	Mathematical Methods in Micromechanics	2 SWS	Lecture / 🗣	Böhlke, Langhoff
Exams					
WT 24/25	76-T-MACH-110378	Mathematical Methods in Micromechanics			Böhlke

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam (180 min). Additives as announced.

prerequisite to registration to the exam: Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

Prerequisites
Passing the tutorial to Mathematical Methods in Micromechanics (T-MACH-110379)

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110379 - Tutorial Mathematical Methods in Micromechanics must have been passed.

Workload
150 hours

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

V Mathematical Methods in Micromechanics

2162280, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Fundamentals of linear isotropic and anisotropic thermoelasticity theory,
Description of microstructures,
Micro-macro relations of linear thermoelasticity theory,
Approximations and bounds for the effective thermoelastic material behavior,
Microstructure Sensitive Design of materials,
Selected problems in the context of homogenization of nonlinear material properties

Literature

- Vorlesungsskript
- Gummert, P.; Reckling, K.-A.: Mechanik. Vieweg 1994
- Gross, D., Seelig, T.: Bruchmechanik – Mit einer Einführung in die Mikromechanik, Springer 2002
- Klingbeil, E.: Variationsrechnung, BI Wissenschaftsverlag, 1977
- Torquato, S.: Random Heterogeneous Materials. Springer, 2002

T 5.111 Course: Measurement and Control Systems [T-MACH-103622]

Responsible: Prof. Dr.-Ing. Christoph Stiller
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	3137020	Measurement and Control Systems	3 SWS	Lecture / 🗣	Stiller
WT 24/25	3137021	Measurement and Control Systems (Tutorial)	1 SWS	Practice / 🗣	Stiller
Exams					
WT 24/25	76-T-MACH-103622	Measurement and Control Systems			Stiller

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (30 min)

Prerequisites
none

Workload
180 hours

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

V Measurement and Control Systems
3137020, WS 24/25, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Lehrinhalt (EN):

1 Dynamic systems
2 Properties of important systems and modeling
3 Transfer characteristics and stability
4 Controller design
5 Fundamentals of measurement
6 Estimation
7 Sensors
8 Introduction to digital measuremen

Lernhziele (EN):

Measurement and control of physical entities is a vital requirement in most technical applications. Such entities may comprise e.g. pressure, temperature, flow, rotational speed, power, voltage and electrical current, etc.. From a general perspective, the objective of measurement is to obtain information about the state of a system while control aims to influence the state of a system in a desired manner. This lecture provides an introduction to this field and general systems theory. The control part of the lecture presents classical linear control theory. The measurement part discusses electrical measurement of non-electrical entities.

Nachweis (EN): written exam; duration 2,5 h; paper reference materials only (no calculator)

Arbeitsaufwand (EN): 180 hours

Organizational issues
Die Vorlesung startet am 22.10.2024.

Literature

- Measurement and Control Systems:

R.H. Cannon: Dynamics of Physical Systems, McGraw-Hill Book Comp., New York,1967
G.F. Franklin: Feedback Control of Dynamic Systems, Addison-Wesley Publishing Company, USA, 1988
R. Dorf and R. Bishop: Modern Control Systems, Addison-Wesley
C. Phillips and R. Harbor: Feedback Control Systems, Prentice-Hall

- Regelungstechnische Bücher:

J. Lunze: Regelungstechnik 1 & 2, Springer-Verlag
R. Unbehauen: Regelungstechnik 1 & 2, Vieweg-Verlag
O. Föllinger: Regelungstechnik, Hüthig-Verlag
W. Leonhard: Einführung in die Regelungstechnik, Teubner-Verlag
Schmidt, G.: Grundlagen der Regelungstechnik, Springer-Verlag, 2. Aufl., 1989

- Messtechnische Bücher:

E. Schrüfer: Elektrische Meßtechnik, Hanser-Verlag, München, 5. Aufl., 1992
U. Kiencke, H. Kronmüller, R. Eger: Meßtechnik, Springer-Verlag, 5. Aufl., 2001
H.-R. Tränkler: Taschenbuch der Messtechnik, Verlag Oldenbourg München, 1996
W. Pfeiffer: Elektrische Messtechnik, VDE Verlag Berlin 1999
Kronmüller, H.: Prinzipien der Prozeßmeßtechnik 2, Schnäcker-Verlag, Karlsruhe, 1. Aufl., 1980

V	**Measurement and Control Systems (Tutorial)** 3137021, WS 24/25, 1 SWS, Language: English, Open in study portal	**Practice (Ü)** **On-Site**

Content
Tutorial for Measurement and Control Systems

5.112 Course: Mechanical Properties of Nanomaterials and Microsystems [T-MACH-114071]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Competence Certificate
Oral examination, ca. 30 min

Prerequisites
Course T-MACH-114018 must not have been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114018 - Mechanical Properties of Nanomaterials and Microsystems must not have been started.

Workload
120 hours

T 5.113 Course: Mechanical Properties of Nanomaterials and Microsystems [T-MACH-114018]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2178420	Mechanical Properties of Nanomaterials and Microsystems	2 SWS	Lecture / 🗣	Kirchlechner, Gruber, Weygand
Exams					
ST 2025	76-T-MACH-114018	Mechanical Properties of Nanomaterials and Microsystems			Kirchlechner, Gruber, Weygand

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam ca. 30 minutes

Prerequisites
Mutual exclusion with T-MACH-114071

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-114071 - Mechanical Properties of Nanomaterials and Microsystems must not have been started.

Workload
120 hours

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

V Mechanical Properties of Nanomaterials and Microsystems

2178420, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

1. Introduction: Application and properties of micro- and nanosystems; Overview on size effects

2. Fundamentals: Dislocation plasticity (definition of a dislocation; dislocation density, mobility, dislocation sources, statistical aspects incl. SSDs and GNDs).

3. Single crystal plasticity: mechanical and microstructure characterization, mechanisms and their size dependence.

4. Interface plasticity: Compatibility, slip transfer mechanisms, expected size effects.

5. Modelling of mechanisms causing size effects in crystals and at grain boundaries, e.g. dislocation dynamics.

6. Thin film materials: synthesis, characterization and mechanical properties.

7. Nanocrystalline materials: Synthesis, outstanding mechanical properties

8. Elektro-mechanical conversion: piezo-resistive, piezo-elektric, elektrostatic, ...

9. Actuation: inverse piezoelectric effect, shape-memory, electromagnetic, …

The students know and understand size and scaling effects in micro- and nanosystems based on the fundamental microstructure mechanisms at play. They can describe the mechanical behavior of nano- and microstructured materials and analyze and explain the origin for the differences compared to classical material behavior. They are able to explain suitable processing routes, experimental characterization techniques and adequate modelling schemes for nano- and microstructured materials. They also understand the relevance of mechanical phenomena in small dimensions and can judge how they determine material processing as well the performance and the design of microsensors and microactuators.

regular attendance: 22,5 hours

self-study: 97,5 hours

oral exam ca. 30 minutes

Literature

1. M. Ohring: „The Materials Science of Thin Films“, Academic Press, 1992
2. L.B. Freund and S. Suresh: „Thin Film Materials

T 5.114 Course: Mechanics and Strength of Polymers [T-MACH-105333]

Responsible: Hon.-Prof. Dr. Bernd-Steffen von Bernstorff
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2173580	Mechanics and Strengths of Polymers	2 SWS	Lecture / 🗣	von Bernstorff
Exams					
WT 24/25	76-T-MACH-105333	Mechanics and Strengths of Polymers			von Bernstorff

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Recommendation
Basic knowledge in materials science (e.g. lecture materials science I and II)

Workload
120 hours

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

V Mechanics and Strengths of Polymers

2173580, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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).

Organizational issues
berndvonbernstorff@t-online.de

Literature
Literaturliste, spezielle Unterlagen und ein Teilmanuskript werden in der Vorlesung ausgegeben

T 5.115 Course: Metal Forming [T-MACH-105177]

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

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2150681	Metal Forming	2 SWS	Lecture / 🗣	Herlan

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral Exam (20 min)

Prerequisites
none

Workload
120 hours

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

V Metal Forming
2150681, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

Organizational issues

Vorlesungstermine freitags, wöchentlich.
Die konkreten Termine werden in der ersten Vorlesung bekannt gegeben und auf der Institutshomepage und ILIAS veröffentlicht.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

T 5.116 Course: Metallographic Lab Class [T-MACH-105447]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each term	3

Events					
WT 24/25	2175590	Metallographic Lab Class	3 SWS	Practical course / 🗣	Kauffmann
Exams					
WT 24/25	76-T-MACH-105447	Metallographic Lab Class			Heilmaier, Kauffmann

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Colloquium for every experiment, about 60 minutes, protocol

Prerequisites
T-MACH-114076 - Metallographic Lab Class must not have started.

Workload
120 hours

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

V Metallographic Lab Class

2175590, WS 24/25, 3 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Content
The lab course deals with the practical application of metallographic procedures, e.g. starting from sample extraction to light optical (LOM) and scanning electron microscopy (SEM). The preparation of metallographic samples takes up to two lab days. LOM and SEM analyses are performed on another two days. All results are carefully registered by the students and discussed in a spearate session. Finally, the students can independently apply their theoretical and practical knowledge by the preparation and analysis of industrial relevant metallic materials. The content of the lab course will be documented in the form of individual protocols by the students.

Before starting with the lab course, the students need to prepare the fundamentals that are tested in an online test. Lecture notes as starting point are provided.

Learning objectives:

The students can perform standard metallographic preparation routines as well as qualitative and quantitative microstructure analysis. The students are able to interpret microstructures and the correlations of microstructural constituent and processing and properties of metallic materials.

Prerequisites:

Materials Science and Engineering I and II or Materials Physics und Metals

Arbeitsaufwand:

on-site: 25 h
private studies: 95 h

Literature
Praktikumsskript

Weiterführende Informationen gibt es hier:

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)
https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften

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 5.117 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-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	1

Events					
WT 24/25	2141501	Micro Magnetic Resonance	2 SWS	Seminar /	MacKinnon, Badilita, Jouda, Korvink
Exams					
WT 24/25	76-T-MACH-105782	Micro Magnetic Resonannce			Korvink, MacKinnon

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Own Presentation, participation at the course discussions, result is passed or failed.

Prerequisites
none

Workload
120 hours

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

V Micro Magnetic Resonance

2141501, WS 24/25, 2 SWS, Language: English, Open in study portal

Seminar (S)
Blended (On-Site/Online)

T 5.118 Course: Microstructure-Property-Relationships [T-MACH-110931]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103713 - Properties

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2177020	Microstructure-Property-Relationships	3 SWS	Lecture / Blended	Kirchlechner, Avadanii, Bansal, Vrellou, Gruber
Exams					
WT 24/25	76-T-MACH-110931	Microstructure-Property-Relationships			Kirchlechner, Gruber
ST 2025	76-T-MACH-110931	Microstructure-Property-Relationships			Gruber, Kirchlechner

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Exercises for Microstructure-Properties-Relationships is the condition for the admittance to the oral exam in Microstructure-Properties-Relationships.

T-MACH-107683 - Übungen zu Gefüge-Eigenschafts-Beziehungen has not been started.

T-MACH-107604 - Gefüge-Eigenschafts-Beziehungen has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-110930 - Exercises for Microstructure-Property-Relationships must have been passed.
2. The course T-MACH-107683 - Exercises for Microstructure-Property-Relationships must not have been started.
3. The course T-MACH-107604 - Microstructure-Property-Relationships must not have been started.

Workload
120 hours

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

V Microstructure-Property-Relationships
2177020, WS 24/25, 3 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content
The following microstructure-property-relationships will be discussed for all material classes:

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Electrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic properties und materials

In addition to the phenomenological description and physical explanation of the material properties an overview on the corresponding experimental techniques will be given.

The students fundamentally understand the interrelation between the microstructure and the properties of a material. This interrelation will be elaborated for mechanical properties (elasticity, plasticity, fracture, fatigue, creep) as well as functional properties (conductivity, magnetic properties) for all material classes, respectively. The students are able to phenomenological describe the material properties, to explain the underlying physical mechanisms and to understand how the properties can be specifically modified by the microstructure of the material. In the other way they are able to deduce the mechanical and functional properties of a material on the basis of its microstructure.

oral exam ca. 30 minutes

5.119 Course: Microstructure-Property-Relationships [T-MACH-107604]

Responsible: Dr. Patric Gruber
Prof. Dr. Christoph Kirchlechner
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103713 - Properties

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	4

Events					
ST 2025	2178124	Microstructure-Property-Relationships	3 SWS	Lecture / 🗣	Kirchlechner, Gruber
Exams					
WT 24/25	76-T-MACH-107604	Microstructure-Properties-Relationships			Kirchlechner, Gruber
ST 2025	76-T-MACH-107604	Microstructure-Property-Relationships			Kirchlechner, Gruber

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral examination (about 30 min)

Prerequisites
The successful participation in Übungen zu Gefüge-Eigenschafts-Beziehungen is the condition for the admittance to the oral exam in Gefüge-Eigenschafts-Beziehungen.

T-MACH-110930 - Exercises for Microstructure-Properties-Relationships has not been started.

T-MACH-110931 - Microstructure-Properties-Relationships has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107683 - Exercises for Microstructure-Property-Relationships must have been passed.
2. The course T-MACH-110930 - Exercises for Microstructure-Property-Relationships must not have been started.
3. The course T-MACH-110931 - Microstructure-Property-Relationships must not have been started.

Workload
120 hours

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

V Microstructure-Property-Relationships
2178124, SS 2025, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

The following microstructure-property-relationships will be discussed for all material classes:

- Elasticity and plasticity
- Fracture mechanics
- Fatigue
- Creep
- Elektrical conductivity: Metallic conductors, semiconductors, superconductors, conductive polymers
- Magnetic propetries und materials

In addition to the phenomenological description and physical explanation of the material properties an overview on the corresponding experimental techniques will be given.

The students fundamentally understand the interrelation between the microstructure and the properties of a material. This interrelation will be elaborated for mechanical properties (elasticity, plasticity, fracture, fatigue, creep) as well as functional properties (conductivity, magnetic properties) for all material classes, respectively. The students are able to phenomenological describe the material properties, to explain the underlying physical mechanisms and to understand how the properties can be specifically modified by the microstructure of the material. In the other way they are able to deduce the mechanical and functional properties of a material on the basis of its microstructure.

oral exam ca. 30 minutes

T 5.120 Course: Microsystem Simulation [T-MACH-108383]

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

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	1

Competence Certificate
written exam

Prerequisites
none

Workload
120 hours

T 5.121 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-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2183702	Modelling of Microstructures	3 SWS	Lecture / Practice (/ 🗣	August, Prahs, Nestler, Koeppe
Exams					
WT 24/25	76-T-MACH-105303	Modelling of Microstructures			August, Weygand, Nestler

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam 30 min

Prerequisites
none

Recommendation
materials science
fundamental mathematics

Workload
120 hours

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

V Modelling of Microstructures

2183702, WS 24/25, 3 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

Content

- Brief Introduction in thermodynamics
- Gibbs free energy and phase diagrams
- Free energy functional
- Phasefield equation
- Driving forces
- Grand chemical potential functional and the evolution equations
- Numeric solution of the phasefield equation

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.
- explain the mechanisms of phase boundary motion induced under driving forces
- use the phase-field method for simulation of microstructure formation processes
- have 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

oral exam ca. 30 min

Organizational issues

Terminvereinbarung für die mündliche Prüfung: Sobald Sie wissen, wann Sie die Prüfung ablegen möchten, schreiben Sie bitte eine Mail an die Prüferin Anastasia August (anastasia.august2@kit.de) und schlagen Sie einen oder mehrere Termin/e vor. Die Prüfung dauert ca. 30 Minuten.

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

T 5.122 Course: Modern Characterization Methods for Materials and Catalysts [T-CHEMBIO-107822]

Organisation: KIT Department of Chemistry and Biosciences

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

T 5.123 Course: Multi-Scale Plasticity [T-MACH-105516]

Responsible: Prof. Dr. Christian Greiner
PD Dr.-Ing. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2181750	Multi-scale Plasticity	2 SWS	Lecture / 🗣	Greiner, Schulz
Exams					
WT 24/25	76-T-MACH-105516	Multi-Scale Plasticity			Schulz, Greiner

Legend: 🖥 Online, ❁ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, about 30 min

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics, physics, mechanics and materials science

Annotation

- limited number of participants
- mandatory registration
- mandatory attendance

Workload
120 hours

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

V Multi-scale Plasticity

2181750, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

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%)

The maximum number of students is 14 per semester.

Organizational issues
Blockveranstaltung in 5 Blöcken, Termine und Ort werden bekannt gegeben.

Anmeldung per Email an katrin.schulz@kit.edu bis zum 29.09.2024

T 5.124 Course: Nano-Optics [T-PHYS-102282]

Responsible: PD Dr. Andreas Naber
Organisation: KIT Department of Physics
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	2

Events					
WT 24/25	4020021	Nano-Optics	3 SWS	Lecture / 🗣	Naber
WT 24/25	4020022	Exercises to Nano-Optics	1 SWS	Practice / 🗣	Naber
Exams					
WT 24/25	7800099	Nano-Optics			Naber

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.125 Course: Nanotribology and -Mechanics [T-MACH-102167]

Responsible: Prof. Dr. Martin Dienwiebel
apl. Prof. Dr. Hendrik Hölscher

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	5

Events					
WT 24/25	2182712	Nanotribology and -Mechanics	2 SWS	Block / 🗣	Dienwiebel
ST 2025	2182712	Nanotribology and -Mechanics	2 SWS	Lecture / Practice (/ 🗣	Dienwiebel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, about 25 min

Prerequisites
none

Recommendation
preliminary knowlegde in mathematics and physics

Workload
120 hours

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

V Nanotribology and -Mechanics

2182712, WS 24/25, 2 SWS, Language: English, Open in study portal

Block (B)
On-Site

Content
In the summer semester the lecture is offered in German and in the winter semester in English!

Part 1: Fundamentals of nanotribology

- General tribology / nanotechnology
- Forces and dissipation on the nanometer scale
- Experimental methods (SFA, QCM, FFM)
- Prandtl-Tomlinson model
- Superlubricity
- Carbon-based tribosystems
- Electronic friction
- Nanotribology in liquids
- Atomic abrasion
- nanolubrication

Part 2: Topical papers

The student can

- explain the physical foundations and common models used in the field of nanotribology and nanomechanics
- describe the most important experimental methods in nanotribology
- critically evaluate scientific papers on nanotribological issues with respect to their substantial quality

preliminary knowlegde in mathematics and physics recommended

regular attendance: 22,5 hours
preparation for presentation: 22,5 hours
self-study: 75 hours

presentation (40%) and oral examination (30 min, 60%)
no tools or reference materials

Organizational issues
Email registration to lecturer by 10/10/2024: martin.dienwiebel@kit.edu

Anmeldung per Email bis zum 10.10.2024 an den Dozenten: martin.dienwiebel@kit.edu

Literature
Tafelbilder, Folien, Kopien von Artikeln

V **Nanotribology and -Mechanics** — **Lecture / Practice (VÜ)** **On-Site**
2182712, SS 2025, 2 SWS, Language: German, Open in study portal

Content
In the summer semester the lecture is offered in German and in the winter semester in English!

Part 1: Fundamentals of nanotribology

- General tribology / nanotechnology
- Forces and dissipation on the nanometer scale
- Experimental methods (SFA, QCM, FFM)
- Prandtl-Tomlinson model
- Superlubricity
- Carbon-based tribosystems
- Electronic friction
- Nanotribology in liquids
- Atomic abrasion
- nanolubrication

Part 2: Topical papers

The student can

- explain the physical foundations and common models used in the field of nanotribology and nanomechanics
- describe the most important experimental methods in nanotribology
- critically evaluate scientific papers on nanotribological issues with respect to their substantial quality

preliminary knowlegde in mathematics and physics recommended

regular attendance: 22,5 hours
preparation for presentation: 22,5 hours
self-study: 75 hours

presentation (40%) and oral examination (30 min, 60%)
no tools or reference materials

Organizational issues

Die Vorlesung wird auf Deutsch (SoSe) und auf Englisch (WiSe) angeboten!

Lecture will be offered for the last time in winter semester 2025/2026 and then replaced by: Energy Efficient and Sustainable Tribological Systems

Kontakt: martin.dienwiebel@kit.edu

Literature

Edward L. Wolf
Nanophysics and Nanotechnology, Wiley-VCH, 2006

C. Mathew Mate
Tribology on the Small Scale: A Bottom Up Approach to Friction, Lubrication, and Wear (Mesoscopic Physics and Nanotechnology) 1st Edition, Oxford University Press

Tafelbilder, Folien, Kopien von Artikeln

T 5.126 Course: Non-ferros metals and alloys [T-MACH-111826]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2174555	Non-ferros metals and alloys	3 SWS	Lecture / 🗣	Heilmaier

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 min.)

Prerequisites
none

Workload
120 hours

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

V Non-ferros metals and alloys

2174555, SS 2025, 3 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
This lecture gives an introduction in the material physics of non-ferrous metals and alloys. Focus is placed on:

- Synthesis and manufacturing
- Constitution (phase diagrams)
- Microstructure
- Mechanical and physical properties

which determine their respective applications. Since the students get an overview of the potentials and limitations of non-ferrous metals and alloys, they will receive the expertise to assess and decide about their different possible fields of applications.

Literature
Materialkunde der Nichteisenmetalle und Legierungen, J. Freudenberger und M. Heilmaier, Wiley-VCH 2020

T 5.127 Course: Nonlinear Continuum Mechanics [T-MACH-111026]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation:
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2162344	Nonlinear Continuum Mechanics	4 SWS	Lecture / 🗣	Böhlke
Exams					
WT 24/25	76-T-MACH-111026	Nonlinear Continuum Mechanics			Böhlke

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (approx. 25 min)

Prerequisites
Passing the "Tutorial Nonlinear Continuum Mechanics" (T-MACH-111027) is a prerequisite for taking part in the exam.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-111027 - Tutorial Nonlinear Continuum Mechanics must have been passed.

Workload
180 hours

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

V Nonlinear Continuum Mechanics

2162344, SS 2025, 4 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content

- tensor calculus, kinematics, balance equations
- principles of material theory
- finite elasticity
- infinitesimal elasto(visco)plasticity
- exact solutions of infinitesimal plasticity
- finite elasto(visco)plasticity
- infinitesimal and finite crystal(visco)plasticity
- hardening and failure
- strain localization

Organizational issues
Mit Zustimmung aller Teilnehmenden kann die Lehrveranstaltung auch auf Deutsch gehalten werden.

Literature

- Vorlesungsskript / 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.
- Wriggers, P.: Nonlinear Finite Element Methods. Springer 2008.

T 5.128 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-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	4

Events					
WT 24/25	2141865	Novel actuators and sensors	2 SWS	Lecture / 🗣	Kohl, Sommer
Exams					
WT 24/25	76-T-MACH-102152	Novel Actuators and Sensors			Kohl, Sommer
ST 2025	7600010	Novel Actuators and Sensors			Kohl
ST 2025	76-T-MACH-102152	Novel Actuators and Sensors			Sommer, Kohl

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, 60 minutes

Prerequisites
T-MACH-114036 must not be started

Workload
120 hours

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

V Novel actuators and sensors
2141865, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Literature
- Vorlesungsskript "Neue Aktoren" und Folienskript "Sensoren"
- 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 5.129 Course: Optical Engineering [T-ETIT-100676]

Responsible: Prof. Dr. Wilhelm Stork
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2311629	Optical Engineering	2 SWS	Lecture /	Stork
WT 24/25	2311631	Tutorial for 2311629 Optical Engineering	1 SWS	Practice /	Fan
Exams					
WT 24/25	7311629	Optical Engineering			Stork

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Achievement will be examined in an oral examination (approx. 20 minutes)

Prerequisites
none

T 5.130 Course: Optical Transmitters and Receivers [T-ETIT-100639]

Responsible: Prof. Dr. Wolfgang Freude
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2309460	Optical Transmitters and Receivers	2 SWS	Lecture / 🗣	Freude
WT 24/25	2309461	Tutorial for 2309460 Optical Transmitters and Receivers	2 SWS	Practice / 🗣	Freude, N.N.
Exams					
WT 24/25	7309460	Optical Transmitters and Receivers			Freude
ST 2025	7309460	Optical Transmitters and Receivers			Freude

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.131 Course: Optical Waveguides and Fibers [T-ETIT-101945]

Responsible: Prof. Dr.-Ing. Christian Koos
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2309464	Optical Waveguides and Fibers	2 SWS	Lecture / 🗣	Koos, N.N., Bao
WT 24/25	2309465	Tutorial for 2309464 Optical Waveguides and Fibers	1 SWS	Practice / 🗣	Koos, N.N.
Exams					
WT 24/25	7309464	Optical Waveguides and Fibers			Koos
ST 2025	7309464	Optical Waveguides and Fibers			Koos

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.132 Course: Optoelectronic Components [T-ETIT-101907]

Responsible: Prof. Dr.-Ing. Sebastian Randel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2309486	Optoelectronic Components	2 SWS	Lecture /	Randel
ST 2025	2309487	Optoelectronic Components (Tutorial)	1 SWS	Practice /	Randel
Exams					
WT 24/25	7309486	Optoelectronic Components			Randel
ST 2025	7309486	Optoelectronic Components			Randel

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Prerequisites
none

T 5.133 Course: Optoelectronics [T-ETIT-100767]

Responsible: Prof. Dr. Ulrich Lemmer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	3

Events					
WT 24/25	2313726	Optoelectronics	2 SWS	Lecture / ✕	Lemmer
WT 24/25	2313728	Übungen zu 2313726 Optoelektronik	1 SWS	Practice / ✕	Lemmer
ST 2025	2313726	Optoelectronics	2 SWS	Lecture / 🗣	Lemmer
ST 2025	2313728	Übungen zu 2313726 Optoelektronik	1 SWS	Practice / 🗣	Lemmer
Exams					
WT 24/25	7313726	Optoelectronics			Lemmer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The success check is carried out in the context of a written exam (90 minutes).

Prerequisites
none

Recommendation
Knowledge of solid state electronics

T 5.134 Course: Phase Transformations in Materials [T-MACH-111391]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Oral examination	4	Grade to a third	Each winter term	1 terms	1

Events					
WT 24/25	2173421	Phase Transformations in Materials	3 SWS	Lecture / 🗣	Kauffmann, Heilmaier, Sen
Exams					
WT 24/25	76-T-MACH-111391	Phase Transformations in Materials			Kauffmann
ST 2025	76-T-MACH-111391	Phase Transformations in Materials			Kauffmann

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (about 25 min.)

Prerequisites
none

Recommendation
Materials Science and Engineering I/II and some additional fundamentals on thermodynamics and diffusion or Materials Physics and Metals

Workload
120 hours

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

V Phase Transformations in Materials

2173421, WS 24/25, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
Learning objectives:

Students are familiar with a generalized scheme of phase transformations important in materials science and engineering. This includes qualitative and quantitative description of thermodynamics and kinetics of phase transformations. The students are able to apply their fundamental knowledge in order to describe important phase transformations and to deduce properties of materials undergoing these transformations.

Content:

Ch. 0: General Information

Ch. 1: Thermodynamic and Kinetic Fundamentals

- Thermodynamics
- Kinetics
- Overview About Phase Transformations/Schemes

Ch. 2: Experimental Techniques

- General Terms
- Structural Investigations
- Physical Investigations
- Chemical Investigations
- Microstructural Investigations

Ch. 3: Single-Component Systems

- Solidification and Allotropic Transformations
    - Soldification of Elements
        - Nucleation
        - Homogeneous
        - Heterogeneous
        - Growth
            - Temperature-Time-Dependence
            - Facet Energies
            - Facet Growth
            - Heat Transfer (Thermal Dendrites)
    - Allotropic Transformations
        - Nucleation
            - Impact of Elastic Strain Energy
            - Interface Types
        - Growth
            - Temperature-Time-Dependence
- Continuous Phase Transitions

Ch. 4: Multi-Component Systems

- Reconstructive Transformation
    - Solidification of Solid Solutions
    - Spinodal Decomposition
    - Eutectic and Eutectoid Reactions
    - Peritectic and Peritectoid Reactions
    - Precipitation and Ageing
- Displacive Transformation
    - Intermediate Transformations
    - Order Transition
    - Massive Transformation

Work Load

lectures*:* 36 h

private studies*: 64* h

Organizational issues
Details about the lecture are distributed via: https://www.iam.kit.edu/wk/english/studies.php

Literature

Powerpoint slides will be distributed via the ILIAS system.

Detailed information are available for different sub topics of the lecture from:

D. A. Porter, K. E. Easterling, M. Y. Sherif: “Phase transformations in metals and alloys”, CRC Press (2009)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC27759961X

H.K.D.H. Bhadeshia: “Diffusional formation of ferrite in iron and its alloys” in Progress in Materials Science 29 (1985) 321-386
https://doi.org/10.1016/0079-6425(85)90004-0 [currently not available from KIT network but maybe accessed by LEA]

H.K.D.H. Bhadeshia, R.W.K. Honeycomb: “Steels: microstructures and properties”, Butterworth-Heinemann imprint by Elsevier (2017)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC518051110 [free online access from within KIT network]

H.K.D.H. Bhadeshia: “Bainite in steels: transformations, microstructure and properties”, Institute of Materials, London (1992)
https://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC030295610

R.W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland und andere (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/institutes/imw/events/lectures/lecture-notes/physikalische-werkstoffeigenschaften/ [public domain]

T 5.135 Course: Photovoltaics [T-ETIT-101939]

Responsible: Prof. Dr.-Ing. Michael Powalla
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2313737	Photovoltaics	3 SWS	Lecture / 🗣	Powalla, Lemmer
ST 2025	2313738	Tutorial 2313737 Photovoltaik	1 SWS	Practice / 🗣	Powalla, Lemmer
Exams					
WT 24/25	7313737	Photovoltaics			Powalla, Lemmer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
"M-ETIT-100524 - Solar Energy" must not have started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-100774 - Solar Energy must not have been started.

T 5.136 Course: Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle [T-MACH-105537]

Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2189906	Physical and chemical principles of nuclear energy in view of reactor accidents and back-end of nuclear fuel cycle	2 SWS	Lecture / 🗣	Dagan, Metz
Exams					
WT 24/25	76-T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle			Dagan
ST 2025	76-T-MACH-105537	Physical and Chemical Principles of Nuclear Energy in View of Reactor Accidents and Back-End of Nuclear Fuel Cycle			Dagan

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, approx. 30 min.

Prerequisites
none

Workload
120 hours

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)
On-Site

2189906, WS 24/25, 2 SWS, Language: German, Open in study portal

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

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.

Literature

AEA öffentliche Dokumentation zu den nukleare Ereignissen

K. Wirtz: Grundlagen der Reaktortechnik Teil I, II, Technische Hochschule Karlsruhe 1966

D. Emendorfer. K.H. Höcker: Theorie der Kernreaktoren, Teil I, II BI- Hochschultaschenbücher 1969

J. Duderstadt and L. Hamilton: Nuclear reactor Analysis, J. Wiley $ Sons , Inc. 1975 (in Englisch)

R.C. Ewing: The nuclear fuel cycle: a role for mineralogy and geochemistry. Elements vol. 2, p.331-339, 2006 (in Englisch)

J. Bruno, R.C. Ewing: Spent nuclear fuel. Elements vol. 2, p.343-349, 2006 (in Englisch)

T 5.137 Course: Plastic Electronics / Polymerelectronics [T-ETIT-100763]

Responsible: Prof. Dr. Ulrich Lemmer
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2313709	Polymerelectronics/ Plastic Electronics	2 SWS	Lecture / 🗘	Hernandez Sosa
Exams					
WT 24/25	7313709	Plastic Electronics / Polymerelectronics			Lemmer, Hernandez Sosa

Legend: 🖥 Online, 🗘 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The control of success takes place within the framework of an oral overall examination (approx. 30 minutes).

Prerequisites
none

Recommendation
Knowledge of semiconductor devices

Annotation
Lecture and examination are held in German or English, as required.

T 5.138 Course: Plasticity of Metals and Intermetallics [T-MACH-110818]

Responsible: Prof. Dr.-Ing. Martin Heilmaier
Dr.-Ing. Alexander Kauffmann

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each summer term	1

Events					
ST 2025	2173648	Plasticity of Metals and Intermetallics	4 SWS	Lecture / 🗣	Kauffmann, Heilmaier, Schliephake
Exams					
WT 24/25	76-T-MACH-110818	Plasticity of Metals and Intermetallics			Kauffmann, Heilmaier
ST 2025	76-T-MACH-110818	Plasticity of Metals and Intermetallics			Kauffmann, Heilmaier

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
oral exam (about 25 minutes)

Prerequisites
T-MACH-110268 – Plastizität von metallischen und intermetallischen Werkstoffen has not been started

T-MACH-105301 - Werkstoffkunde III has not been started

Workload
240 hours

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

V Plasticity of Metals and Intermetallics

Lecture (V)
On-Site

2173648, SS 2025, 4 SWS, Language: English, Open in study portal

Content
Learning Objectives

Students are familiar with macroscopic, mesoscopic and microscopic mechanisms of plastic deformation in metals, alloys and intermetallics including the qualitative and quantitative descriptions. Furthermore, students can apply their knowledge in order to deduce and explain mechanism-property relationships in this kind of materials and their use in materials manufacturing.

Content

Chapter overview

Ch. 0: General Information
Ch. 1: Relevance of Plasticity in Industry and Research
Ch. 2: Macroscopic Features of Plastic Deformation
Ch. 3: Fundamentals and Interrelations to other Lectures

- Fundamental Concepts of Elasticity
- Macroscopic Strength and Strengthening/Hardening
- Fundamentals of Crystallography
- Fundamentals of Defects in Crystalline Solids

Ch. 4: Dislocations

- Fundamental Concept
- Observation of Dislocations
- Properties of Dislocations
- Dislocations in fcc Metals
- Dislocations in bcc Metals
- Dislocations in hcp Metals and Complex Intermetallics

Ch. 5: Single Crystal Plasticity

- General Stages of Plastic Deformation and Fundamentals of the Stress-Strain curve (fcc Metals)
- Influence of Temperature, Orientation, Strain Rate, etc. (fcc Metals)
- Further Examples (Extension of the Results to bcc, hcp and Intermetallic Materials)
- Deformation Twinning

Ch. 6: Plasticity of Polycrystalline Materials

- Transition from Single Crystals to Polycrystals
- Strength of Polycrystals
    - Solute Atoms
    - Dislocations (incl. Dislocation Patterning)
    - Grain Boundaries (incl. Homogenization of Critical Stress)
    - Precipitates and Dispersoids

Ch. 7: Other Mechanisms of Plastic Deformation

Work Load

lectures: 56 h

private studies: 187 h

Organizational issues
Details about the lecture are distributed via: https://www.iam.kit.edu/wk/english/studies.php

Literature
Powerpoint slides will be distributed via the ILIAS system.

Detailed information are available for different sub topics of the lecture:

P. Hirth, J. Lothe: „Theory of Dislocations“, Krieger (1992)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC070938105

D. Hull, D. J. Bacon: „Introduction to Dislocations“, Elsevier (2011)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC383083990 (free vie KIT license)

R. W. Cahn, P. Haasen (Editoren): „Physical Metallurgy“, Serie, North Holland (1996)
http://services.bibliothek.kit.edu/primo/start.php?recordid=KITSRC052463656

J. Freudenberger: „Skript zur Vorlesung Physikalische Werkstoffeigenschaften“, IFW Dresden (2004)
https://www.ifw-dresden.de/de/ifw-institutes/ikm/lectures/vorlesungsskript-physikalische-werkstoffeigenschaften (public domain)

T 5.139 Course: Polymer Engineering I [T-MACH-102137]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2173590	Polymer Engineering I	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-102137	Polymer Engineering I			Liebig
ST 2025	76-T-MACH-102137	Polymer Engineering I			Liebig

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-114007 must not have been started

Workload
120 hours

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

V Polymer Engineering I

2173590, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

T 5.140 Course: Polymer Engineering II [T-MACH-102138]

Responsible: Dr.-Ing. Wilfried Liebig
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2174596	Polymer Engineering II	2 SWS	Lecture / 🗣	Liebig
Exams					
WT 24/25	76-T-MACH-102138	Polymerengineering II			Liebig
ST 2025	76-T-MACH-102138	Polymerengineering II			Liebig

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
T-MACH-114007 must not be started.

Recommendation
Knowledge in Polymerengineering I

Workload
120 hours

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

V Polymer Engineering II — **Lecture (V) On-Site**
2174596, SS 2025, 2 SWS, Language: German, Open in study portal

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

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).

Literature
Literaturhinweise, Unterlagen und Teilmanuskript werden in der Vorlesung ausgegeben.

Recommended literature and selected official lecture notes are provided in the lecture.

T 5.141 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2141853	Polymers in MEMS A: Chemistry, Synthesis and Applications	2 SWS	/	Worgull
Exams					
WT 24/25	76-T-MACH-102192	Polymers in MEMS A: Chemistry, Synthesis and Applications			Rapp, Worgull

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Oral examination

Prerequisites
none

Workload
120 hours

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

V Polymers in MEMS A: Chemistry, Synthesis and Applications
2141853, WS 24/25, 2 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

Organizational issues
Findet als Blockveranstaltung am Semesterende statt.

T 5.142 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2141854	Polymers in MEMS B: Physics, Microstructuring and Applications	2 SWS	Lecture /	Worgull
Exams					
WT 24/25	76-T-MACH-102191	Polymers in MEMS B: Physics, Microstructuring and Applications			Worgull

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Oral examination

Prerequisites
none

Workload
120 hours

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

V Polymers in MEMS B: Physics, Microstructuring and Applications

2141854, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

T 5.143 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2142855	Polymers in MEMS C - Biopolymers and Bioplastics	2 SWS	/	Worgull
Exams					
WT 24/25	76-T-MACH-102200	Polymers in MEMS C: Biopolymers and Bioplastics			Worgull, Rapp

Legend: Online, Blended (On-Site/Online), On-Site, × Cancelled

Competence Certificate
Oral examination

Prerequisites
none

Workload
120 hours

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

V Polymers in MEMS C - Biopolymers and Bioplastics

2142855, SS 2025, 2 SWS, Language: German, Open in study portal

Blended (On-Site/Online)

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, PD Dr.-Ing. Matthias Worgull (matthias.worgull@kit.edu). Preregistration is not necessary.

Organizational issues

Für weitere Rückfragen, wenden Sie sich bitte an PD Dr.-Ing- Matthias Worgull (matthias.worgull@kit.edu). Eine Voranmeldung ist nicht notwendig.

Literature

Zusätzliche vorlesungsbegleitende Literatur ist nicht notwendig.

T 5.144 Course: Powertrain Systems Technology B: Stationary Machinery [T-MACH-105216]

Responsible: Prof. Dr.-Ing. Tobias Düser
Sascha Ott

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2145150	Powertrain Systems Technology B: Stationary Machinery	2 SWS	Lecture / 🗣	Düser, Ott
Exams					
WT 24/25	76-T-MACH-105216	Powertrain Systems Technology B: Stationary Machinery			Albers, Ott
ST 2025	76-T-MACH-105216	Drive Systems Engineering B: Stationary Machinery			Albers, Ott

Legend: Online, Blended (On-Site/Online), On-Site, ✕ Cancelled

Competence Certificate
written examination: 60 min duration

Prerequisites
None

Workload
120 hours

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

V Powertrain Systems Technology B: Stationary Machinery

2145150, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

Literature
VDI-2241: "Schaltbare fremdbetätigte Reibkupplungen und -bremsen", VDI Verlag GmbH, Düsseldorf

Geilker, U.: "Industriekupplungen - Funktion, Auslegung, Anwendung", Die Bibliothek der Technik, Band 178, verlag moderne industrie, 1999

T 5.145 Course: Practical Course Technical Ceramics [T-MACH-105178]

Responsible: apl. Prof. Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	4	pass/fail	Each winter term	2

Events					
WT 24/25	2125751	Practical Course Technical Ceramics	2 SWS	Practical course / 🗣	Schell
Exams					
WT 24/25	76-T-MACH-105178	Practical Course Technical Ceramics			Schell

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Colloquium and laboratory report for the respective experiments.

Prerequisites
none

Workload
30 hours

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

V Practical Course Technical Ceramics
2125751, WS 24/25, 2 SWS, Language: German, Open in study portal

Practical course (P)
On-Site

Organizational issues
Elektronisch über das ILIAS-Portal

Literature
Salmang, H.: Keramik, 7. Aufl., Springer Berlin Heidelberg, 2007. - Online-Ressource

Richerson, D. R.: Modern Ceramic Engineering, CRC Taylor & Francis, 2006

T 5.146 Course: Practical in Additive Manufacturing for Process Engineering [T-CIWVT-110903]

Responsible: TT-Prof. Dr. Christoph Klahn
Organisation: KIT Department of Chemical and Process Engineering
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Version
Completed coursework (practical)	1	pass/fail	1

Events					
ST 2025	2241021	Practical in Additive Manufacturing for Process Engineering	1 SWS	Practical course / 🗣	Klahn

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, x Cancelled

T 5.147 Course: Principles of Ceramic and Powder Metallurgy Processing [T-MACH-102111]

Responsible: apl. Prof. Dr. Günter Schell
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2193010	Basic principles of powder metallurgical and ceramic processing	2 SWS	Lecture / Blended	Schell
Exams					
WT 24/25	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell, Wagner
ST 2025	76-T-MACH-102111	Principles of Ceramic and Powder Metallurgy Processing			Schell

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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

Workload
120 hours

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

V Basic principles of powder metallurgical and ceramic processing
2193010, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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 5.148 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2149670	Product- and Production-Concepts for modern Automobiles	2 SWS	Lecture / Blended	Steegmüller, Kienzle
Exams					
WT 24/25	76-T-MACH-110318	Product- and Production-Concepts for modern Automobiles			Steegmüller, Kienzle

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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.

Workload
120 hours

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

V Product- and Production-Concepts for modern Automobiles
2149670, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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.

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

Organizational issues
Termine werden über Ilias bekannt gegeben.

Bei der Vorlesung handelt es sich um eine Blockveranstaltung. Eine Anmeldung über Ilias ist erforderlich.

Zur Vertiefung des im Rahmen der Lehrveranstaltung erworbenen Wissens werden die theoretischen Vorlesungseinheiten durch Praxiseinheiten im Umfeld der Karlsruher Forschungsfabrik (https://www.karlsruher-forschungsfabrik.de) unterstützt.

The lecture is a block course. An application in Ilias is mandatory.

The theoretical lectures are complemented by practical lectures in the Karlsruhe Research Factory (https://www.karlsruher-forschungsfabrik.de/en.html) to deepen the acquired knowledge.

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt.

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

T 5.149 Course: Product Lifecycle Management [T-MACH-105147]

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

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2121350	Product Lifecycle Management	2 SWS	Lecture / 🗣	Ovtcharova, Meyer, Rönnau
Exams					
WT 24/25	76-T-MACH-105147	Product Lifecycle Management			Ovtcharova, Meyer, Rönnau
WT 24/25	76-T-MACH-105147-mdl	Product Lifecycle Management			Elstermann
ST 2025	76-T-MACH-105147	Product Lifecycle Management			Ovtcharova, Rönnau, Meyer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Writen examination 90 min.

Prerequisites
None

Workload
120 hours

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

V Product Lifecycle Management
2121350, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
The course includes:

- Basics for product data management and data exchange
- IT system solutions for Product Lifecycle Management (PLM)
- Economic viability analysis and implementation problems
- Illustrative scenario for PLM using the example of the institute's own I4.0Lab

After successful attendance of the course, students can:

- identify the challenges of data management and exchange and describe solution concepts for these challenges.
- clarify the management concept PLM and its goals and highlight the economic benefits.
- explain the processes required to support the product life cycle and describe the most important business software systems (PDM, ERP, ...) and their functions.

Literature
Vorlesungsfolien.

V. Arnold et al: Product Lifecycle Management beherrschen, Springer-Verlag, Heidelberg, 2005.

J. Stark: Product Lifecycle Management, 21st Century Paradigm for Product Realisation, Springer-Verlag, London, 2006.

A. W. Scheer et al: Prozessorientiertes Product Lifecycle Management, Springer-Verlag, Berlin, 2006.

J. Schöttner: Produktdatenmanagement in der Fertigungsindustrie, Hanser-Verlag, München, 1999.

M.Eigner, R. Stelzer: Produktdaten Management-Systeme, Springer-Verlag, Berlin, 2001.

G. Hartmann: Product Lifecycle Management with SAP, Galileo press, 2007.

K. Obermann: CAD/CAM/PLM-Handbuch, 2004.

T 5.150 Course: Product, Process and Resource Integration in the Automotive Industry [T-MACH-102155]

Responsible: Prof. Dr.-Ing. Sama Mbang
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Competence Certificate
Oral examination 20 min.

Prerequisites
None

Annotation
Limited number of participants.

Workload
120 hours

T 5.151 Course: Project Internship Additive Manufacturing: Development and Production of an Additive Component [T-MACH-110960]

Responsible: Prof. Dr.-Ing. Frederik Zanger
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2149700	Project Internship Aditive Manufacturing: Development and Production of an Additive Component	2 SWS	Practical course / 🗣	Zanger, Frey
ST 2025	2149700	Project Internship Aditive Manufacturing: Development and Production of an Additive Component	2 SWS	Practical course / 🗣	Zanger, Frey
Exams					
WT 24/25	76-T-MACH-110960	Project Internship Aditive Manufacturing: Development and Production of an Additive Component			Zanger

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Alternative test achievement (graded)

The competence certificate is a project work; alternative test achievement according to § 4 Abs. 2 No. 3 of the SPO. Here, the project work, the milestone-based presentation of the results in presentation form (10 min each) and a final oral examination (15 min) are included in the assessment.

Prerequisites
none

Workload
120 hours

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

V Project Internship Aditive Manufacturing: Development and Production of an Additive Component

Practical course (P)
On-Site

2149700, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company.
The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rewor

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study.
Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:

The students …

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:

regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Die Veranstaltung beginnt mit einer Blockveranstaltung vor Semesterbeginn. Während des Semesters finden nur einzelne Pflichtveranstaltungen statt. Die genauen Termine werden über die Vorlesungsankündigung des wbk mitgeteilt: http://www.wbk.kit.edu/studium-und-lehre.php

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) zur Verfügung gestellt.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

V **Project Internship Aditive Manufacturing: Development and Production of an Additive Component** — **Practical course (P) On-Site**
2149700, SS 2025, 2 SWS, Language: German, Open in study portal

Content
The lecture "Project Internship Additive Manufacturing: Development and Production of an Additive Component" combines the basics of metallic laser powder bed fusion (LPBF) with a development project in cooperation with an industrial company.
The students learn the basics of the following topics in the project-related lecture:

- Influence of different process variables on the component quality of parts produced in the LPBF process
- Preparation and simulation of the LPBF process
- Production of additive metallic components
- Process monitoring and quality assurance in additive manufacturing
- Topology optimization
- CAM for subtractive rewor

The topics addressed in the course will be applied practically in various workshops on the individual topics and transferred to the developmental task in self-study.
Finally, the results of the elaborations are produced additively and post-processed subtractively.

Learning Outcomes:

The students …

- are able to describe the properties and applications of the additive manufacturing processes laser powder bed fusion (LPBF).
- are able to select the appropriate manufacturing process for a technical application.
- are able to describe and implement the creation of a product along the entire additive process chain (CAD, simulation, work preparation, CAM) from the idea to the production.
- are able to discuss the development process for components that are optimized for additive manufacturing.
- are able to perform topology optimization.
- are able to simulate the additive process, compensate for process-related distortions and determine the ideal alignment on the building platform.
- are able to create necessary support structures for the additive process and to derive a building order file.
- are able to create a CAM model for the subtractive rework process of additive parts.

Workload:

regular attendance: 12 hours
self-study: 108 hours

Organizational issues
Die Veranstaltung beginnt mit einer Blockveranstaltung vor Semesterbeginn. Während des Semesters finden nur einzelne Pflichtveranstaltungen statt. Die genauen Termine werden über die Vorlesungsankündigung des wbk mitgeteilt: http://www.wbk.kit.edu/studium-und-lehre.php

Aus organisatorischen Gründen ist die Teilnehmerzahl für die Lehrveranstaltung begrenzt. Infolgedessen wird ein Auswahlprozess stattfinden. Der Link zur Bewerbung wird in der Vorlesungsankündigung über die Homepage des wbk (http://www.wbk.kit.edu/studium-und-lehre.php) zur Verfügung gestellt.

Literature
Skript zur Veranstaltung wird über Ilias (https://ilias.studium.kit.edu/) bereitgestellt.

T 5.152 Course: Quality Management [T-MACH-102107]

Responsible: Prof. Dr.-Ing. Gisela Lanza
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2149667	Quality Management	2 SWS	Lecture / Blended	Lanza, Stamer
Exams					
WT 24/25	76-T-MACH-102107	Quality Management			Lanza

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
Written Exam (60 min)

Prerequisites
It is not possible to combine this brick with brick Quality Management [T-MACH-112586].

Workload
120 hours

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

V Quality Management
2149667, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
Blended (On-Site/Online)

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

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

Organizational issues
Vorlesungstermine montags 09:45 Uhr
Übung erfolgt während der Vorlesung

Literature
Medien:
Skript zur Veranstaltung wird über (https://ilias.studium.kit.edu/) bereitgestellt:

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

T 5.153 Course: Rail System Technology [T-MACH-106424]

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

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	4

Events					
WT 24/25	2115919	Rail System Technology	2 SWS	Lecture / 🗣	Cichon
ST 2025	2115919	Rail System Technology	2 SWS	Lecture / 🗣	Cichon
Exams					
WT 24/25	76-T-MACH-106424	Rail System Technology			Cichon
ST 2025	76-T-MACH-106424	Rail System Technology			Cichon

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
writen examination in German language
Duration: 60 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

Prerequisites
none

Workload
120 hours

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

V Rail System Technology
2115919, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

V Rail System Technology
2115919, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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, comparison electric traction and diesel traction, dc and ac networks, system pantograph and contact wire, filling stations

Organizational issues
ab SS 2024 schriftliche Prüfung

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

T 5.154 Course: Rail Vehicle Technology [T-MACH-105353]

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

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each term	4

Events					
WT 24/25	2115996	Rail Vehicle Technology	2 SWS	Lecture / 🗣	Cichon
ST 2025	2115996	Rail Vehicle Technology	2 SWS	Lecture / 🗣	Cichon
Exams					
WT 24/25	76-T-MACH-105353	Rail Vehicle Technology			Cichon
ST 2025	76-T-MACH-105353	Rail Vehicle Technology			Cichon

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
writen examination in German language
Duration: approx 60 minutes
No tools or reference materials may be used during the exam except calculator and dictionary

Prerequisites
none

Workload
120 hours

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

V Rail Vehicle Technology
2115996, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: priciples, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

V Rail Vehicle Technology
2115996, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content

1. Vehicle system technology: structure and main systems of rail vehicles
2. Car body: functions, requirements, design principles, crash elements, coupling, doors and windows
3. Bogies: forces, running gears, bogies, Jakobs-bogies, active components, connection to car body, wheel arrangement
4. Drives: priciples, electric drives (main components, asynchronous traction motor, inverter, with DC supply, with AC supply, without line supply, multisystem vehicles, dual mode vehicles, hybrid vehicles), non-electric drives
5. Brakes: basics, principles (wheel brakes, rail brakes, blending), brake control (requirements and operation modes, pneumatic brake, electropneumatic brake, emergency brake, parking brake)
6. Train control management system: definition of TCMS, bus systems, components, network architectures, examples, future trends
7. Vehicle concepts: trams, metros, regional trains, intercity trains, high speed trains, double deck vehicles, locomotives, freight wagons

Organizational issues
ab SS 2024 schriftliche Prüfung

Literature
Eine Literaturliste steht den Studierenden auf der Ilias-Plattform zum Download zur Verfügung.

A bibliography is available for download (Ilias-platform).

T 5.155 Course: Registration for Certificate Issuance - Supplementary Studies on Science, Technology and Society [T-FORUM-113587]

Responsible: Dr. Christine Mielke
Christine Myglas

Organisation:

Part of: M-FORUM-106753 - Supplementary Studies on Science, Technology and Society

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	0	pass/fail	Each term	1

Prerequisites

In order to register, it is mandatory that the basic module and the advanced module have been completed and that the grades for the partial performances in the advanced module are available.

Registration as a partial achievement means the issue of a certificate.

T 5.156 Course: Robotics I - Introduction to Robotics [T-INFO-108014]

Responsible: Prof. Dr.-Ing. Tamim Asfour
Organisation: KIT Department of Informatics
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	2

Events					
WT 24/25	2424152	Robotics I - Introduction to Robotics		Lecture / 🗣	Asfour, Daab, Hyseni
Exams					
WT 24/25	7500106	Robotics I - Introduction to Robotics			Asfour
ST 2025	7500218	Robotik I - Einführung in die Robotik			Asfour

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment is carried out as a written examination (§ 4 Abs. 2 No. 1 SPO) lasting 120 minutes.

Prerequisites
none.

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

V Robotics I - Introduction to Robotics
2424152, WS 24/25, SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
The lecture provides an overview of the fundamentals of robotics using the examples of industrial robots, service robots and autonomous humanoid robots. An insight into all relevant topics is given. This includes methods and algorithms for robot modeling, control and motion planning, image processing and robot programming. First, mathematical basics and methods for kinematic and dynamic robot modeling, trajectory planning and control as well as algorithms for collision-free motion planning and grasp planning are covered. Subsequently, basics of image processing, intuitive robot programming especially by human demonstration and symbolic planning are presented.

In the exercise, the theoretical contents of the lecture are further illustrated with examples. Students deepen their knowledge of the methods and algorithms by independently working on problems and discussing them in the exercise. In particular, students can gain practical programming experience with tools and software libraries commonly used in robotics.

Workload:

Lecture with 3 SWS + 1 SWS Tutorial, 6 LP

6 LP corresponds to 180 hours, including

15 * 3= 45 hours attendance time (lecture)

15 * 1= 15 hours attendance time (tutorial)

15 * 6= 90 hours self-study and exercise sheets

30 hours preparation for the exam

Competency Goals:

The students are able to apply the presented concepts to simple and realistic tasks from robotics. This includes mastering and deriving the mathematical concepts relevant for robot modeling. Furthermore, the students master the kinematic and dynamic modeling of robot systems, as well as the modeling and design of simple controllers. The students know the algorithmic basics of motion and grasp planning and can apply these algorithms to problems in robotics. They know algorithms from the field of image processing and are able to apply them to problems in robotics. They are able to model and solve tasks as a symbolic planning problem. The students have knowledge about intuitive programming procedures for robots and know procedures for programming and learning by demonstration.

Organizational issues

Die Erfolgskontrolle erfolgt in Form einer schriftlichen Prüfung im Umfang von i.d.R. 120 Minuten nach § 4 Abs. 2 Nr. 1 SPO.

Modul für Bachelor/Master Informatik, Maschinenbau, Mechatronik und Informationstechnik, Elektrotechnik und Informationstechnik

Literature

Weiterführende Literatur

Fu, Gonzalez, Lee: Robotics - Control, Sensing, Vision, and Intelligence

Russel, Norvig: Artificial Intelligence - A Modern Approach, 2nd. Ed.

T 5.157 Course: Scientific Computing for Engineers [T-MACH-100532]

Responsible: Prof. Dr. Peter Gumbsch
Dr. Daniel Weygand

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2181738	Scientific computing for Engineers	2 SWS	Lecture / 🗣	Weygand, Gumbsch
WT 24/25	2181739	Exercises for Scientific Computing for Engineers	2 SWS	Practice / 🗣	Weygand
Exams					
WT 24/25	76-T-MACH-100532	Scientific Computing for Engineers			Weygand, Gumbsch

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
Written exam (90 minutes)

Prerequisites
The brick can not be combined with the brick "Application of advanced programming languages in mechanical engineering" (T-MACH-105390).

Workload
120 hours

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

V Scientific computing for Engineers

2181738, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
1. Introduction: why scientific computing
2. computer architectures
3. Introduction to Unix/Linux
4. Foundations of C++
* progamm organization
* data types, operator, control structures
* dynamic memory allocation
* functions
* class
* OpenMP parallelization
5. numeric /algorithms
* finite differences
* MD simulations: 2nd order differential equations
* algorithms for particle simulations
* solver for linear systems of eqns.

The student can

- apply the programming language C++ for scientific computing in the field of materials science
- adapt programs for use on parallel platforms
- choose suitable numerical methods for the solution of differential equations.

The lecture can not be combined with the lecture "Application of advanced programming languages in mechanical engineering" (2182735).

regular attendance: 22,5 hours
Lab: 22,5 hours (optional)
self-study: 75 hours

written exam 90 minutes

Literature

1. C++: Einführung und professionelle Programmierung; U. Breymann, Hanser Verlag München
2. C++ and object-oriented numeric computing for Scientists and Engineers, Daoqui Yang, Springer Verlag.
3. The C++ Programming Language, Bjarne Stroustrup, Addison-Wesley
4. Die C++ Standardbibliothek, S. Kuhlins und M. Schader, Springer Verlag

Numerik:

1. Numerical recipes in C++ / C / Fortran (90), Cambridge University Press
2. Numerische Mathematik, H.R. Schwarz, Teubner Stuttgart
3. Numerische Simulation in der Moleküldynamik, Griebel, Knapek, Zumbusch, Caglar, Springer Verlag

V **Exercises for Scientific Computing for Engineers** — Practice (Ü) On-Site
2181739, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
Exercises for the different topics of the lecture "Scientific computing for Engineers" (2181738)

regular attendance: 22,5 hours

Organizational issues
Veranstaltungsort (RZ Pool Raum) wird in Vorlesung bekannt gegeben

Literature
Skript zur Vorlesung "Wissenschaftliches Programmieren für Ingenieure" (2181738)

T 5.158 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Graded [T-MACH-113324]

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

Part of: M-MACH-103721 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	1	Grade to a third	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 5.159 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Graded [T-MACH-112687]

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

Part of: M-MACH-103721 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	1	Grade to a third	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 5.160 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Graded [T-MACH-113322]

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

Part of: M-MACH-103721 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	1	Grade to a third	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 5.161 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded [T-MACH-113321]

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

Part of: M-MACH-103721 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 5.162 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded [T-MACH-112686]

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

Part of: M-MACH-103721 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 5.163 Course: Self-Booking-MSc-HOC-SPZ-FORUM-Non-Graded [T-MACH-113323]

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

Part of: M-MACH-103721 - Key Competencies

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each term	1

Competence Certificate
Completed coursework

Prerequisites
None

Self service assignment of supplementary stdues
This course can be used for self service assignment of grade aquired from the following study providers:

- House of Competence
- Sprachenzentrum
- Studium Generale. Forum Wissenschaft und Gesellschaft (FORUM) (ehem. ZAK)

Annotation
Interdisciplinary qualifications (IQ) completed at the House-of-Competence (HoC), at the Zentrum für Angewandte Kulturwissenschaften (ZAK) or at the Sprachenzentrum (SpZ) can be assigned in self-service.

First, select a partial accomplishment named "self-assignment" in your study schedule and second, assign an IQ-achievement via the tab "IQ achievements".

Workload
60 hours

T 5.164 Course: Seminar "Materials Modelling" [T-MACH-107660]

Responsible: Prof. Dr. Britta Nestler
PD Dr.-Ing. Katrin Schulz
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each term	3

Events					
WT 24/25	2183717	Seminar "Materials Modelling"	4 SWS	Seminar / Blended	Gumbsch, Nestler, Böhlke, August, Schulz, Prahs, Weygand
ST 2025	2183717	Seminar "Materials Modeling"	4 SWS	Seminar / On-Site	Nestler, Gumbsch, Böhlke, Weygand
Exams					
WT 24/25	76-T-MACH-107660	Seminar "Materials Modelling"			Gumbsch, Nestler, Böhlke, Weygand, Schulz, Selzer, August, Koeppe

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The control of success is a project work; examination of another type according to article 4 paragraph 2 number 3 of the studies and examination regulations. The project thesis (30-40 pages) and the final presentation (about 30 min) enter the final grading.

Prerequisites
T-MACH-113814 – Seminar Materials Simulation has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-113814 - Seminar Materials Simulation must not have been started.

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
240 hours

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

V Seminar "Materials Modelling"

2183717, WS 24/25, 4 SWS, Language: German/English, Open in study portal

Seminar (S)
Blended (On-Site/Online)

Content
The topic of the seminar has to be related to the major field "Computational Materials Science" and has to refer to subject-specific or interdisciplinary problems relating to latest research activities at the involved institutes.

The student

- can independently elaborate a scientific problem in the field of "Computational Materials Science".
- can accomplish a scientific literature search.
- can choose suitable methods as well as techniques and use or refine them to solve his problem.
- can compare and evaluate his/her results with the latest state of the art.
- can present his/her scientific results both written and oral.

preliminary knowlegde in mathematics, physics and materials science recommende

regular attendance: 45 hours

self-study: 195 hours

Grading based on a written seminar paper (60%) of 30-40 pages and an oral presentation (40%) of 30 min with following discussion.

Organizational issues
Weitere Informationen in den Vorlesungen und Sprechstunden der Dozenten/in!

V **Seminar "Materials Modeling"**
2183717, SS 2025, 4 SWS, Language: German/English, Open in study portal

Seminar (S)
On-Site

Content
The topic of the seminar has to be related to the major field "Computational Materials Science" and has to refer to subject-specific or interdisciplinary problems relating to latest research activities at the involved institutes.

The student

- can independently elaborate a scientific problem in the field of "Computational Materials Science".
- can accomplish a scientific literature search.
- can choose suitable methods as well as techniques and use or refine them to solve his problem.
- can compare and evaluate his/her results with the latest state of the art.
- can present his/her scientific results both written and oral.

preliminary knowlegde in mathematics, physics and materials science recommende

regular attendance: 45 hours

self-study: 195 hours

Grading based on a written seminar paper (60%) of 30-40 pages and an oral presentation (40%) of 30 min with following discussion.

Organizational issues
Weitere Informationen in den Vorlesungen und Sprechstunden der Dozenten/innen!

T 5.165 Course: Seminar Materials Simulation [T-MACH-113814]

Responsible: Prof. Dr. Britta Nestler
PD Dr.-Ing. Katrin Schulz

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Examination of another type	8	Grade to a third	Each term	1

Events					
WT 24/25	2183717	Seminar "Materials Modelling"	4 SWS	Seminar /	Gumbsch, Nestler, Böhlke, August, Schulz, Prahs, Weygand
Exams					
WT 24/25	76-T-MACH-113814	Seminar Materials Simulation			Nestler, Gumbsch, Böhlke, Weygand, Schulz, Selzer, August

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The control of success is a project work; examination of another type according to article 4 paragraph 2 number 3 of the studies and examination regulations. The project thesis (30-40 pages) and the final presentation (about 30 min) enter the final grading.

Prerequisites
T-MACH-107660 – Seminar Werkstoffsimulation has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107660 - Seminar "Materials Modelling" must not have been started.

Recommendation
preliminary knowlegde in mathematics, physics and materials science

Workload
240 hours

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

V Seminar "Materials Modelling"

2183717, WS 24/25, 4 SWS, Language: German/English, Open in study portal

Seminar (S)
Blended (On-Site/Online)

Content
The topic of the seminar has to be related to the major field "Computational Materials Science" and has to refer to subject-specific or interdisciplinary problems relating to latest research activities at the involved institutes.

The student

- can independently elaborate a scientific problem in the field of "Computational Materials Science".
- can accomplish a scientific literature search.
- can choose suitable methods as well as techniques and use or refine them to solve his problem.
- can compare and evaluate his/her results with the latest state of the art.
- can present his/her scientific results both written and oral.

preliminary knowlegde in mathematics, physics and materials science recommende

regular attendance: 45 hours

self-study: 195 hours

Grading based on a written seminar paper (60%) of 30-40 pages and an oral presentation (40%) of 30 min with following discussion.

Organizational issues

Weitere Informationen in den Vorlesungen und Sprechstunden der Dozenten/in!

T 5.166 Course: Sensor Systems [T-ETIT-100709]

Responsible: Dr. Wolfgang Menesklou
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

T 5.167 Course: Sensors [T-ETIT-101911]

Responsible: Dr. Wolfgang Menesklou
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2304231	Sensors	2 SWS	Lecture / 🗣	Menesklou
Exams					
WT 24/25	7304231	Sensors			Menesklou
ST 2025	7304231	Sensors			Menesklou

Legend: 🖥 Online, ❁ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 5.168 Course: Simulation of Nanoscale Systems, without Seminar [T-PHYS-102504]

Responsible: Prof. Dr. Wolfgang Wenzel
Organisation: KIT Department of Physics
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Irregular	1

Prerequisites
none

T 5.169 Course: Simulation of the Process Chain of Continuously Fiber Reinforced Composite Structures [T-MACH-105971]

Responsible: Prof. Dr.-Ing. Luise Kärger
Organisation: KIT Department of Mechanical Engineering
Lightweight Design
Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	3

Events					
ST 2025	2114107	Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile	2 SWS	Lecture / Practice (/ 🗣	Kärger
Exams					
ST 2025	76-T-MACH-105971	Simulation of the process chain of continuously fiber reinforced composite structure			Kärger

Legend: 🖥 Online, ⚄ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, approx. 20 minutes

Prerequisites
T-MACH-114003 and T-MACH-114004 must not have been started.

Workload
120 hours

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

V Simulation der Prozesskette kontinuierlich verstärkter Faserverbundbauteile

Lecture / Practice (VÜ)
On-Site

2114107, SS 2025, 2 SWS, Language: German, Open in study portal

Content

The lecture deals with methods for the calculation of FRP components with continuous fiber reinforcement and provides the necessary understanding of materials and processes. The material behavior of fiber composites is largely determined by the fiber structure. This must be suitably modeled in the single layer and in the multilayer composite in order to be able to reliably predict the deformation and damage behavior of FRP components. In the case of curved components, the fiber structure is only created during the manufacturing process, specifically during the forming (draping) of the two-dimensional semi-finished products into a three-dimensional structure (preform). In addition, there is the mold filling process, in which the preform is infiltrated with a reactive resin system, as well as the curing process, which can lead to distortion and residual stresses. In addition to the simulation of structural behavior, process simulation is therefore an essential building block for the holistic development of fiber composite components. The main contents are:

- Virtual Process Chain
- Draping simulation: draping behavior of textiles
  draping process, kinematic draping simulation, FE draping simulation
- Molding simulation: Principles of fluid mechanics, viscosity and permeability, molding simulation within the CAE chain
- Curing simulation and distortion: process of crosslinking, resin kinetics, thermomechanics, internal stresses, part distortion
- Structural simulation: Modelling of multilayer laminate,
  influence of manufacturing effects

Study goals:

The students understand that the microstructure of fibre reinforces plastics (FRP) and the resulting material behavior is mainly influenced by the manufacturing process. They know the simulation steps needed to virtually describe the process chain of RTM (resin transfer molding) parts. They are able to explain the principal mechanical processes of draping, molding and curing and can name their influences on the structural behavior.

Workload:

lectures: 21h, preparation of examination: 63h

Literature

Altenbach, J. Altenbach, and R. Rikards: Einführung in die Mechanik der Laminat- und Sandwichtragwerke. Deutscher Verlag für Grundstoffindustrie, Stuttgart, 1. edition, 1996.

Altenbach, J. Altenbach, W. Kissing; Mechanics of Composite Structural Elements . ISBN 978-3-642-07411-0 Springer-Verlag Berlin Heidelberg, 2004.

Barbero, J.: Introduction to Composite Materials Design. CRC Press, Boca Raton, FL, 2. edition, 2011.

Bickerton, S.; Sozer, E.M. Simacek, P. and Advani, S.G.: “Fabric structure and mold curvature effects on preform permeability and mold filling in the RTM process. Part II. Predictions and comparisons with experiments”. Composites Part A 31: 439–458, 2000.

Henning, F.; Moeller, E.: Handbuch Leichtbau: Methoden, Werkstoffe, Fertigung. Carl Hanser Verlag GmbH & Co. KG, 2011.

Kärger, L.; Bernath, A.; Fritz, F.; Galkin, S.; Magagnato, D.; Oeckerath, A.; Schön, A.; Henning, F.: Development and validation of a CAE chain for unidirectional fibre reinforced composite components. Composite Structures 132: 350–358, 2015.

Puck A: Festigkeitsanalyse von Faser-Matrix-Laminaten, Modelle für die Praxis. Carl Hanser Verlag, München, Wien, 1. edition, 1996.

Schürmann H: Konstruieren mit Faserverbundwerkstoffen. ISBN 3-540-40283-7 . Springer Verlag, 2005.

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 5.170 Course: Single-Photon Detectors [T-ETIT-108390]

Responsible: Dr. Konstantin Ilin
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2312680	Single-Photon Detectors	2 SWS	Lecture / 🗣	Ilin
WT 24/25	2312694	Tutorial for 2312680 Single-Photon Detectors	1 SWS	Practice / 🗣	Ilin
Exams					
WT 24/25	7312680	Single-Photon Detectors			Ilin
ST 2025	7312680	Single-Photon Detectors			Kempf, Ilin

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.171 Course: Solar Energy [T-ETIT-100774]

Responsible: Prof. Dr. Bryce Sydney Richards
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	6	Grade to a third	Each winter term	1

Events					
WT 24/25	2313745	Solar Energy	3 SWS	Lecture / 🗣	Richards, Paetzold
WT 24/25	2313750	Tutorial 2313745 Solar Energy	1 SWS	Practice / 🗣	Richards, Paetzold
Exams					
WT 24/25	7313745	Solar Energy			Richards, Paetzold

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Prerequisites
Students not allowed to take either of the following modules in addition to this one: „Solarenergie“ (M-ETIT-100476) and „Photovoltaik“ (M-ETIT-100513).

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-101939 - Photovoltaics must not have been started.

T 5.172 Course: Solar Thermal Energy Systems [T-MACH-106493]

Responsible: apl. Prof. Dr. Ron Dagan
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	4

Events					
WT 24/25	2189400	Solar Thermal Energy Systems	2 SWS	Lecture / 🗣	Dagan
Exams					
WT 24/25	76-T-MACH-106493	Solar Thermal Energy Systems			Dagan
ST 2025	76-T-MACH-106493	Solar Thermal Energy Systems			Dagan

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Workload
120 hours

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

V Solar Thermal Energy Systems

2189400, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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.

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.

Organizational issues

Die Vorlesung "Thermische Solarenergie" findet ab dem WS 2024/25 nicht mehr statt. Sie wurde zusammengelegt mit der engl. Version "Solar Thermal Energy Systems"

Literature

- "Solar Engineering of Thermal Processes "4th Edition, J. Duffie &W. Beckman. Published by Wiley & Sons.
- "Heat Transfer", 10th Edition, P. Holman Mc. Graw Hill publisher.
- "Fundamentals of classical Thermodynamics", G. Van Wylen & R. E. Sonntag. Published by Wiley & Sons

T 5.173 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-103711 - Kinetics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	4

Events					
WT 24/25	2193003	Solid State Reactions and Kinetics of Phase Transformations	2 SWS	Lecture / 🗣	Franke
Exams					
WT 24/25	76-T-MACH-107667	Solid State Reactions and Kinetics of Phase			Seifert, Franke

Legend: 🖥 Online, ✣ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (about 30 min)

Prerequisites
The successful participation in Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion is the condition for the admittance to the oral exam in Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion.

T-MACH-110926 – Exercises for Solid State Reactions and Kinetics of Phase Transformations has not been started.

T-MACH-110927 – Solid State Reactions and Kinetics of Phase has not been started.

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.
2. The course T-MACH-110927 - Solid State Reactions and Kinetics of Phase Transformations must not have been started.
3. The course T-MACH-110926 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must not have been started.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physical chemistry

Workload
120 hours

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

V Solid State Reactions and Kinetics of Phase Transformations — **Lecture (V) On-Site**
2193003, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
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

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 5.174 Course: Solid State Reactions and Kinetics of Phase Transformations [T-MACH-110927]

Responsible: Prof. Dr.-Ing. Bronislava Gorr
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103711 - Kinetics

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2194722	Solid State Reactions and Kinetics of Phase Transformations, Corrosion	2 SWS	Lecture / 🗣	Gorr, Tang
Exams					
WT 24/25	76-T-MACH-110927	Solid State Reactions and Kinetics of Phase			Gorr

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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.

T-MACH-107632 – Übungen zu Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion has not been started.

T-MACH-107667 – Festkörperreaktionen / Kinetik von Phasenumwandlungen, Korrosion has not been started.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-107667 - Solid State Reactions and Kinetics of Phase must not have been started.
2. The course T-MACH-110926 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must have been passed.
3. The course T-MACH-107632 - Exercises for Solid State Reactions and Kinetics of Phase Transformations must not have been started.

Recommendation
Bacic course in materials science and engineering

Basic course in mathematics

physical chemistry

Workload
120 hours

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

V Solid State Reactions and Kinetics of Phase Transformations, Corrosion

Lecture (V)
On-Site

2194722, SS 2025, 2 SWS, Language: English, Open in study portal

Content
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

Organizational issues
The lecture will take place in building 10.91, room 228.

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 5.175 Course: Solid-State Optics, without Exercises [T-PHYS-104773]

Responsible: PD Dr. Michael Hetterich
Organisation: KIT Department of Physics
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	2

Events					
WT 24/25	4020011	Solid-State-Optics	4 SWS	Lecture / 🗣	Hetterich
Exams					
WT 24/25	7800104	Solid-State Optics, without Exercises			Hetterich

Legend: 🖥 Online, ✲ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Prerequisites
none

T 5.176 Course: Spectroscopy with Electrons and Soft X-rays [T-CHEMBIO-107821]

Organisation: KIT Department of Chemistry and Biosciences
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

T 5.177 Course: Structural and Phase Analysis [T-MACH-102170]

Responsible: Dr.-Ing. Susanne Wagner
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Exams			
WT 24/25	76-T-MACH-102170	Structural and Phase Analysis	Wagner, Hinterstein
ST 2025	76-T-MACH-102170	Structural and Phase Analysis	Wagner

Competence Certificate
Oral examination

Prerequisites
none

T 5.178 Course: Superconducting Magnet Technology [T-ETIT-113440]

Responsible: Prof. Dr. Tabea Arndt
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2312698	Superconducting Magnet Technology	3 SWS	Lecture / Practice (/	Arndt

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The examination takes place in form of an oral exam (abt. 30 minutes).

Two timeslots (weeks) for examination dates will be announced (usually near end of lecture period & end of semester).

The module grade is the grade of the oral exam.

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111096 - Superconducting Materials must not have been started.
2. The course T-ETIT-111239 - Superconductivity for Engineers must not have been started.

T 5.179 Course: Superconducting Materials [T-ETIT-111096]

Responsible: Prof. Dr. Bernhard Holzapfel
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each term	2

Events					
WT 24/25	2312717	Superconducting Materials Part I	2 SWS	Lecture / 🗣	Holzapfel, Hänisch
ST 2025	2312696	Superconducting Materials Part II	2 SWS	Lecture / 🗣	Holzapfel, Hänisch

Legend: 🖥 Online, ⚃ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment of success takes place in the form of an oral examination lasting 40 minutes.

The oral examination includes the contents of Superconducting Materials Part I (offered every winter term) and Superconducting Materials Part II (offered every summer term).

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111239 - Superconductivity for Engineers must not have been started.

Recommendation
Knowledge of the basic course “Superconductivity for Engineers” is required

T 5.180 Course: Superconducting Power Systems [T-ETIT-113439]

Responsible: Prof. Dr.-Ing. Mathias Noe
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2314011	Superconducting Power Systems	3 SWS	Lecture / Practice (/	Noe
Exams					
WT 24/25	7300034	Superconducting Power Systems			Noe

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

Competence Certificate
The examination takes place in form of an oral exam (abt. 45 minutes).

The module grade is the grade of the oral exam.

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111096 - Superconducting Materials must not have been started.
2. The course T-ETIT-111239 - Superconductivity for Engineers must not have been started.

T 5.181 Course: Superconductivity for Engineers [T-ETIT-111239]

Responsible: Prof. Dr. Bernhard Holzapfel
Prof. Dr. Sebastian Kempf

Organisation: KIT Department of Electrical Engineering and Information Technology

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Expansion	Version
Written examination	5	Grade to a third	Each winter term	1 terms	3

Events					
WT 24/25	2312708	Superconductivity for Engineers	2 SWS	Lecture / 🗣	Kempf, Holzapfel
WT 24/25	2312709	Exercise for 2312708 Superconductivity for Engineers	1 SWS	Practice / 🗣	Ilin, Hänisch
Exams					
WT 24/25	7312708	Superconductivity for Engineers			Kempf
ST 2025	7312691	Superconductivity for Engineers			Kempf, Holzapfel

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
The assessment of success takes place in the form of a written examination lasting 120min. The grade corresponds to the result of the written examination.

Prerequisites
none

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-ETIT-111096 - Superconducting Materials must not have been started.

T 5.182 Course: Superhard Thin Film Materials [T-MACH-111257]

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

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2194729	Superhard Thin Film Materials	2 SWS	Lecture / 🗣	Ulrich
Exams					
WT 24/25	76-T-MACH-111257	Superhard Thin Film Materials			Ulrich
ST 2025	76-T-MACH-111257	Superhard Thin Film Materials			Ulrich

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (ca. 30 Minuten)

Prerequisites
Either "Superharte Dünnschichtmaterialien“, "Superhard Thin Film Materials“ or "Constitution and Properties of Wearresistant Materials“ can be chosen within the Focal Course.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102103 - Superhard Thin Film Materials must not have been started.
2. The course T-MACH-102141 - Constitution and Properties of Wearresistant Materials must not have been started.

Recommendation
none

Workload
120 hours

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

V Superhard Thin Film Materials

2194729, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

Content
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.

Recommendations: none

Organizational issues
The block course takes place in the following period:

23.04.-25.04.2025: each time from 8:00-17:15;

Location: KIT-CN, Building 681, Room 214

Binding registration until 16.04.2025 at sven.ulrich@kit.edu.

After registration, you will receive the link to the lecture by e-mail on 22.04.2025 in case of an online event.

Literature
G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed

T 5.183 Course: Superhard Thin Film Materials [T-MACH-102103]

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

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	3

Events					
WT 24/25	2177618	Superhard Thin Film Materials	2 SWS	Lecture / 🗣	Ulrich
Exams					
WT 24/25	76-T-MACH-102103	Superhard Thin Film Materials			Ulrich
ST 2025	76-T-MACH-102103	Superhard Thin Film Materials			Ulrich

Legend: 🖥 Online, ❖ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (ca. 30 Minuten)

Prerequisites
Either "Superharte Dünnschichtmaterialien“, "Superhard Thin Film Materials“ or "Constitution and Properties of Wearresistant Materials“ can be chosen within the Focal Course.

Modeled Conditions
The following conditions have to be fulfilled:

1. The course T-MACH-102141 - Constitution and Properties of Wearresistant Materials must not have been started.
2. The course T-MACH-111257 - Superhard Thin Film Materials must not have been started.

Workload
120 hours

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

V Superhard Thin Film Materials — **Lecture (V) On-Site**
2177618, WS 24/25, 2 SWS, Language: German, Open in study portal

Content
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.

Recommendations: none

Organizational issues
Falls die Vorlesung online stattfinden muss, bitte um Anmeldung unter sven.ulrich@kit.edu bis zum 22.10.24.

Den entsprechenden MS Teams Link erhalten Sie dann per E-Mail am 23.10.24.

Literature
G. Kienel (Herausgeber): Vakuumbeschichtung 1 - 5, VDI Verlag, Düsseldorf, 1994

Abbildungen und Tabellen werden verteilt; Copies with figures and tables will be distributed

T 5.184 Course: Sustainable Vehicle Drivetrains [T-MACH-111578]

Responsible: Prof. Dr. Thomas Koch
Dr.-Ing. Olaf Toedter
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2133132	Sustainable Vehicle Drivetrains	2 SWS	Lecture / 🗣	Toedter
Exams					
WT 24/25	76-T-MACH-105655	Sustainable Vehicle Drivetrains			Toedter

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam (approx. 20 minutes)

Prerequisites
none

Annotation
Starting in winter term 25/26, the course consists of a lecture (2h / week) and a tutorial (1 h / week).

Workload
120 hours

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

V Sustainable Vehicle Drivetrains
2133132, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Sustainability

Environmental balance

Legislation

Alternative fuels

BEV

Fuel cell

Hybrid drives

T 5.185 Course: Technology of Steel Components [T-MACH-105362]

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

Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	2

Events					
ST 2025	2174579	Technology of steel components	2 SWS	Lecture / 🗣	Schulze
Exams					
WT 24/25	76-T-MACH-105362	Technology of Steel Components			Schulze
ST 2025	76-T-MACH-105362	Technology of Steel Components			Schulze

Legend: 📱 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral exam, about 25 minutes

Prerequisites
none

Workload
120 hours

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

V Technology of steel components

2174579, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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

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

Literature

Skript wird in der Vorlesung ausgegeben

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 5.186 Course: The ABC of DFT [T-PHYS-105960]

Responsible: Prof. Dr. Carsten Rockstuhl
Prof. Dr. Wolfgang Wenzel

Organisation: KIT Department of Physics

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Irregular	1

Events					
ST 2025	4023151	The ABC of DFT	2 SWS	Lecture / 🗣	Krstic, Wenzel, Holzer
ST 2025	4023152	Exercises to The ABC of DFT	1 SWS	Practice / 🗣	Wenzel, Holzer

Legend: 🖥 Online, ❋ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

T 5.187 Course: Theoretical Quantum Optics [T-PHYS-110303]

Responsible: Prof. Dr. Anja Metelmann
Prof. Dr. Carsten Rockstuhl

Organisation: KIT Department of Physics

Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Irregular	1

T 5.188 Course: Thermal Turbomachines I [T-MACH-105363]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each winter term	3

Events					
WT 24/25	2169453	Thermal Turbomachines I	3 SWS	Lecture / 🗣	Bauer
WT 24/25	2169454	Tutorial - Thermal Turbo Machines I	2 SWS	Practice / 🗣	Bauer
Exams					
WT 24/25	76-T-MACH-105363	Thermal Turbomachines I			Bauer
WT 24/25	76-T-MACH-105363-Wdh	Thermal Turbomachines I (for repeaters)			Bauer
ST 2025	76-T-MACH-105363	Thermal Turbomachines I			Bauer
ST 2025	76T-Mach-105363-Wdh	Thermal Turbomachines I (for repeater)			Bauer

Legend: 🖥 Online, ❁ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral exam, duration 30 min.

Prerequisites
none

Workload
180 hours

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

V Thermal Turbomachines I

2169453, WS 24/25, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to to describe and analyse not only the individual components but also entire assemblies. The students can asses and evaluate the effects of physical, economical and ecological boundary conditions.

regular attendance: 31,50 h
self-study: 64,40 h

Recommendations:

Recommended in combination with the lecture 'Thermal Turbomachines II'.

Examination:

oral
Duration: approximately 30 min

no tools or reference materials may be used during the exam

Organizational issues
Vorlesung wird nur noch in Englisch gehalten ab WS 2023/24.

Aufzeichnungen in Deutsch aus früheren Vorlesungen werden weiter zur Verfügung gestellt.

Literature
Vorlesungsskript (erhältlich im 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

5.189 Course: Thermal Turbomachines II [T-MACH-105364]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	6	Grade to a third	Each summer term	2

Events					
ST 2025	2170477	Tutorial - Thermal Turbomachines II (Übung - Thermische Turbomaschinen II)	2 SWS	Practice / 🗣	Bauer, Mitarbeiter
ST 2025	2170553	Thermal Turbomachines II (in English)	3 SWS	Lecture / 🗣	Bauer
Exams					
WT 24/25	76-T-MACH-105364	Thermal Turbomachines II			Bauer
WT 24/25	76-T-MACH-105364-Wdh	Thermal Turbomachines II (for repeaters)			Bauer
ST 2025	76-T-MACH-105364	Thermal Turbomachines II			Bauer
ST 2025	76T-Mach-105364-Wdh	Thermal Turbomachines II (for repeaters)			Bauer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
oral exam, duration: 30 min.

Prerequisites
none

Workload
180 hours

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

V Thermal Turbomachines II (in English)

2170553, SS 2025, 3 SWS, Language: English, Open in study portal

Lecture (V)
On-Site

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

Recommendations:

Recommended in combination with the lecture 'Thermal Turbomachines II'.

regular attendance: 31,50 h
self-study: 64,40 h

The students are able to explain and comment on the design and operation of thermal turbomachines in detail. Moreover, they can evaluate the range of applications for turbomachinery. Therefore, students are able to to describe and analyse not only the individual components but also entire assemblies. The students can asses and evaluate the effects of physical, economical and ecological boundary conditions.

Exam:

oral

Duration: approximately 30 min

no tools or reference materials may be used during the exam.

Literature

Vorlesungsskript (erhältlich im 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 5.190 Course: Thermophysics of Advanced Materials [T-MACH-111459]

Responsible: Dr. Dmitry Sergeev
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each term	1

Events					
WT 24/25	2193051	Thermophysics of Advanced Materials	2 SWS	Lecture / 🔀	Sergeev
ST 2025	2193051	Thermophysics of Advanced Materials	2 SWS	Lecture / 🔀	Sergeev
Exams					
WT 24/25	76-T-MACH-111459	Thermophysics of Advanced Materials			Sergeev

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
oral examination (ca. 30 Minuten)

Prerequisites
none

Recommendation

- Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (with exercises)
- Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (with exercises)

Workload
120 hours

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

V Thermophysics of Advanced Materials

2193051, WS 24/25, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content

- Introduction to Thermophysics
- Thermophysical properties of thermal storage materials
- Properties of pure compounds (solid, liquid and gas phase)
- Binary, ternary and multicomponent systems and their phase diagrams
- Experimental methods for determination of thermophysical properties
    - Thermal stability, evaporation and sublimation processes, and thermodynamic properties of the gas phase (thermogravimetry and Knudsen effusion mass spectrometry)
    - Phase transition temperatures and phase diagrams (differential thermal analysis and high temperature X-ray diffraction)
    - Heat capacity, phase transition enthalpies, formation enthalpies, mixing enthalpies (dynamic difference and drop calorimetry)
    - Thermal expansion (dilatometry and high temperature X-ray diffraction)
    - Thermal conductivity (laser flash analysis etc.)
- Thermodynamic databases and software
- Thermodynamic modelling and calculations according to Calphad method using FactSage

To provide a basic understanding of experimental measurement methods for studying binary and ternary phase diagrams and determining thermophysical properties. Furthermore, the participants will learn about different types of thermal energy storage and their application areas, as well as how to perform thermodynamic calculations for optimization and selection of storage materials using FactSage.

regular attendance: 22 hours

self-study: 98 hours

Recommendations:

- Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (with exercises)
- Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (with exercises)

oral examination (about 30 min)

Organizational issues
The lecture will take place in presence or online as follows:

25.10.24

08.11.24

15.11.24

22.11.24

29.11.24

06.12.24

13.12.24

20.12.24

You will be informed about the lecture link (Zoom) in ILIAS.

Literature

Stølen S., Grande T., Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects, John Wiley & Sons, Chichester, 2004

Sprackling M., Thermal physics, Macmillan Education LTD, Hampshire and London, 1991

Tong C., Introduction to Materials for Advanced Energy Systems, Springer, Cham, 2019

Hemminger W.F., Cammenga, H.K.: Methoden der Thermischen Analyse, Springer, Berlin Heidelberg, 1989

Sorai M., Comprehensive Handbook of Calorimetry and Thermal Analysis, John Wiley & Sons, Chichester, 2004

Lukas, H.L., Fries, S.G., Sundman, B.: Computational Thermodynamics: The Calphad Method, Cambridge University Press, New York, 2007

V **Thermophysics of Advanced Materials**
2193051, SS 2025, 2 SWS, Language: English, Open in study portal

Lecture (V)
Blended (On-Site/Online)

Content

- Introduction to Thermophysics
- Thermophysical properties of thermal storage materials
- Properties of pure compounds (solid, liquid and gas phase)
- Binary, ternary and multicomponent systems and their phase diagrams
- Experimental methods for determination of thermophysical properties
    - Thermal stability, evaporation and sublimation processes, and thermodynamic properties of the gas phase (thermogravimetry and Knudsen effusion mass spectrometry)
    - Phase transition temperatures and phase diagrams (differential thermal analysis and high temperature X-ray diffraction)
    - Heat capacity, phase transition enthalpies, formation enthalpies, mixing enthalpies (dynamic difference and drop calorimetry)
    - Thermal expansion (dilatometry and high temperature X-ray diffraction)
    - Thermal conductivity (laser flash analysis etc.)
- Thermodynamic databases and software
- Thermodynamic modelling and calculations according to Calphad method using FactSage

To provide a basic understanding of experimental measurement methods for studying binary and ternary phase diagrams and determining thermophysical properties. Furthermore, the participants will learn about different types of thermal energy storage and their application areas, as well as how to perform thermodynamic calculations for optimization and selection of storage materials using FactSage.

regular attendance: 22 hours

self-study: 98 hours

Recommendations:

- Knowledge of the course "Fundamentals in Materials Thermodynamics and Heterogeneous Equilibria" (with exercises)
- Knowledge of the course "Solid State Reactions and Kinetics of Phase Transformations" (with exercises)

oral examination (about 30 min)

Organizational issues
The lecture will take place in presence or online as follows:

1) 25.04.2025: Presence

2) 02.05.2025: Online

3) 09.05.2025: Online

4) 16.05.2025: Presence

5) 23.05.2025: Online

6) 30.05.2025: Online

7) 06.06.2025: Presence

You will be informed about the lecture link (Zoom) in ILIAS.

Literature
Stølen S., Grande T., Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects, John Wiley & Sons, Chichester, 2004

Sprackling M., Thermal physics, Macmillan Education LTD, Hampshire and London, 1991

Tong C., Introduction to Materials for Advanced Energy Systems, Springer, Cham, 2019

Hemminger W.F., Cammenga, H.K.: Methoden der Thermischen Analyse, Springer, Berlin Heidelberg, 1989

Sorai M., Comprehensive Handbook of Calorimetry and Thermal Analysis, John Wiley & Sons, Chichester, 2004

Lukas, H.L., Fries, S.G., Sundman, B.: Computational Thermodynamics: The Calphad Method, Cambridge University Press, New York, 2007

T 5.191 Course: Thin Films: Technology, Physics and Applications I [T-ETIT-106853]

Responsible: Dr. Konstantin Ilin
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	2

Exams			
WT 24/25	7312670	Thin films: technology, physics and applications I	Ilin
ST 2025	7312670	Thin Films: Technology, Physics and Applications I	Kempf, Ilin

Competence Certificate
The success control takes place within the framework of an oral overall examination of approx. 20 minutes.

Prerequisites
The modul "M-ETIT-102332 - Thin films: technology, physics and applications" may neither be started nor completed.

T 5.192 Course: Thin Films: Technology, Physics, and Applications II [T-ETIT-108121]

Responsible: Dr. Konstantin Ilin
Organisation: KIT Department of Electrical Engineering and Information Technology
Part of: M-MACH-103741 - Functional Materials

Type	Credits	Grading scale	Recurrence	Version
Oral examination	3	Grade to a third	Each summer term	1

Events					
ST 2025	2312671	Superconducting Nanowire Detectors	2 SWS	Lecture / 🗣	Ilin
ST 2025	2312673	Practice to 2312671 Superconducting Nanowire Detectors	1 SWS	Practice / 🗣	Ilin
Exams					
WT 24/25	7312671	Thin films: technology, physics and applications II			Ilin

Legend: 🖥 Online, 🔀 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Oral Exam (20 min.)

T 5.193 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-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	8	Grade to a third	Each winter term	2

Events					
WT 24/25	2181114	Tribology	5 SWS	Lecture / Practice (/ 🗣	Dienwiebel, Scherge
Exams					
WT 24/25	76-T-MACH-105531	Tribology			Dienwiebel

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

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

Workload
240 hours

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

V Tribology

2181114, WS 24/25, 5 SWS, Language: German, Open in study portal

Lecture / Practice (VÜ)
On-Site

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.

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

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 5.194 Course: Turbo Jet Engines [T-MACH-105366]

Responsible: Prof. Dr.-Ing. Hans-Jörg Bauer
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each summer term	1

Events					
ST 2025	2170478	Turbo Jet Engines	2 SWS	Lecture / 🗣	Bauer
Exams					
WT 24/25	76-T-MACH-105366	Turbo Jet Engines			Bauer
ST 2025	76-T-MACH-105366	Turbo Jet Engines			Bauer

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, × Cancelled

Competence Certificate
oral exam, duration: 20 min.

Prerequisites
none

Workload
120 hours

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

V Turbo Jet Engines

2170478, SS 2025, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Content
Introduction to jet engines and their components

Demands on engines and propulsive efficiency

Thermodynamic and gas dynamic fundamentals and design calculations

Components of air breathing engines

Jet engine design and development process

Engine and component design

Current developments in the jet engines industry

The students have the ability to:

- compare the design concepts of modern jet engines
- analyse the operation of modern jet engines
- apply the thermodynamic and fluidmechanic basics of jet engines
- choose the main components intake, compressor, combustor, turbine and thrust nozzle based on given criteria
- comment on different methods for the reduction of pollutant emissions, noise and fuel consumption

regular attendance:21 h
self-study: 42 h

Exam:

oral
Duration: approximately 30 minutes

no tools or reference materials may be used during the exam

Literature

Hagen, H.: Fluggasturbinen und ihre Leistungen, G. Braun Verlag, 1982
Hünnecke, K.: Flugtriebwerke, ihre Technik und Funktion, Motorbuch Verlag, 1993
Saravanamuttoo, H.; Rogers, G.; Cohen, H.: Gas Turbine Theory, 5th Ed., 04/2001
Rolls-Royce: The Jet Engine, ISBN:0902121235, 2005

T 5.195 Course: Tutorial Introduction to the Finite Element Method [T-MACH-110330]

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

Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Events					
ST 2025	2162257	Tutorial Introduction to the Finite Element Method	1 SWS	Practice / 🗣	Lauff, Klein, Langhoff, Böhlke

Legend: 🖥 Online, Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
Successful participation in this course allows for registration to the Exam "Introduction to the Finite Element Method" (see 76-T-MACH-105320)

For students of Mechanical Engineering (BSc) that have chosen the Major Field "Continuum Mechanics" the prerequisites consist of successfully solving the written homework sheets as well as the computational homework sheets during the associated computer tutorials.

For students of Mechanical Engineering that have chosen a different Major Field and for students from different fields of study the prerequisites consist of successfully solving only the written homework sheets.

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.

Due to capacity reasons it is possible that not all students of this course can be admitted to the computer tutorials. Students of the bachelor's degree program in mechanical engineering who have chosen the Major Field Continuum Mechanics (SP-Nr 13) will be admitted to the computer tutorials in any case.
If additional places are available in the computer tutorials for this course, these will be allocated according to the BSc average grade.

Workload
30 hours

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

V Tutorial Introduction to the Finite Element Method

2162257, SS 2025, 1 SWS, Language: German, Open in study portal

Practice (Ü)
On-Site

Content
See lecture "Introduction to the Finite Element Method"

Literature
siehe Vorlesung "Einführung in die Finite-Elemente-Methode"

T 5.196 Course: Tutorial Mathematical Methods in Micromechanics [T-MACH-110379]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation: KIT Department of Mechanical Engineering
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Version
Completed coursework	1	pass/fail	Each summer term	1

Competence Certificate
Successfully solving the homework sheets. Details are given in the first lecture.

Workload
30 hours

T 5.197 Course: Tutorial Nonlinear Continuum Mechanics [T-MACH-111027]

Responsible: Prof. Dr.-Ing. Thomas Böhlke
Organisation:
Part of: M-MACH-103739 - Computational Materials Science

Type	Credits	Grading scale	Recurrence	Expansion	Version
Completed coursework	2	pass/fail	Each summer term	1 terms	2

Exams			
WT 24/25	76-T-MACH-111027	Tutorial Nonlinear Continuum Mechanics	Böhlke

Competence Certificate
Written homework problems

Successful participation in this course allows for registration to the Exam "Nonlinear Continuum Mechanics" (see 76-T-MACH-111026)

Prerequisites
none

Workload
60 hours

T 5.198 Course: Vehicle Lightweight Design - Strategies, Concepts, Materials [T-MACH-114010]

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

Lightweight Design
Part of: M-MACH-103738 - Structural Materials

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Exams			
ST 2025	76-T-MACH-114010	Vehicle Lightweight Design - Strategies, Concepts, Materials	Henning

Competence Certificate
written exam, duration 180 minutes

Prerequisites
T-MACH-114001 - Lightweighting Concepts and Technologies not started

Workload
120 hours

T 5.199 Course: Vibration Theory [T-MACH-105290]

Responsible: Prof. Dr.-Ing. Alexander Fidlin
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each summer term	4

Events					
WT 24/25	2161212	Vibration Theory	2 SWS	Lecture / 🗣	Genda
WT 24/25	2161213	Übungen zu Technische Schwingungslehre	2 SWS	Practice	Genda, Riedel
Exams					
WT 24/25	76-T-MACH-105290	Vibration Theory			Fidlin

Legend: 🖥 Online, ⚙ Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, 180 min.

Prerequisites
Engineering Mechanics III comparable basic knowledge of dynamics

Workload
120 hours

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

V Vibration Theory

2161212, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

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.

Literature
Klotter: Technische Schwingungslehre, Bd. 1 Teil A, Heidelberg, 1978

Hagedorn, Otterbein: Technische Schwingungslehre, Bd. 1 und Bd. 2, Berlin, 1987

Wittenburg: Schwingungslehre, Springer-Verlag, Berlin, 1995

V Übungen zu Technische Schwingungslehre

2161213, WS 24/25, 2 SWS, Language: German, Open in study portal

Practice (Ü)

Content
Exercises related to the lecture

T 5.200 Course: Welding Technology [T-MACH-105170]

Responsible: Dr.-Ing. Majid Farajian
Organisation: KIT Department of Mechanical Engineering

Part of: M-MACH-103740 - Materials Processing

Type	Credits	Grading scale	Recurrence	Version
Oral examination	4	Grade to a third	Each winter term	1

Events					
WT 24/25	2173571	Welding Technology	2 SWS	Block / 🗣	Farajian
Exams					
WT 24/25	76-T-MACH-105170	Welding Technology			Farajian

Legend: Online, Blended (On-Site/Online), On-Site, Cancelled

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.

Workload
120 hours

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

V Welding Technology
2173571, WS 24/25, 2 SWS, Language: German, Open in study portal

Block (B)
On-Site

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

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).

exam:

oral, ca. 20 minutes, no auxiliary material

Organizational issues

Die Blockveranstaltung findet am 23.01.25, 24.01.2025, 30.01.2025, 31.10.2025 jeweils von 09:00 bis 15:00 Uhr in Gebäude 10.91 Raum 380 statt. Anmeldungen erfolgen über den Beitritt zum ILIAS-Kurs. Bei Fragen wenden Sie sich gerne an majid.farajian@kit.edu

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.

T 5.201 Course: Windpower [T-MACH-105234]

Responsible: Norbert Lewald
Organisation: KIT Department of Mechanical Engineering
Institute of Thermal Turbomachinery
Part of: M-MACH-103715 - Technical Specialisation

Type	Credits	Grading scale	Recurrence	Version
Written examination	4	Grade to a third	Each winter term	2

Events					
WT 24/25	2157381	Windpower	2 SWS	Lecture / 🗣	Lewald
Exams					
WT 24/25	76-T-MACH-105234	Windpower			Lewald
ST 2025	76-T-MACH-105234	Windpower			Lewald

Legend: 🖥 Online, 🧩 Blended (On-Site/Online), 🗣 On-Site, ✕ Cancelled

Competence Certificate
written exam, 120 minutes

Prerequisites
none

Workload
120 hours

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

V Windpower

2157381, WS 24/25, 2 SWS, Language: German, Open in study portal

Lecture (V)
On-Site

Karlsruhe Institute of Technology

The Research University in the Helmholtz Association

Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) for the Master's Program of Materials Science and Engineering

The present English translation has no legally binding effect. It is provided for your information only.

This is a condensed translation of the following German documents:

- Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 27. Juni 2017
- Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 26. Februar 2019
- Berichtigung der Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 28. Februar 2019
- Zweite Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 24 Februar 2020
- Vierte Satzung zur Änderung der Studien- und Prüfungsordnung des Karlsruher Instituts für Technologie (KIT) für den Masterstudiengang Materialwissenschaft und Werkstofftechnik, 21. Oktober 2021

Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) for the Master's Program of Materials Science and Engineering

dated June 26, 2017

Pursuant to Article 10, par. 2, clause 5 and Article 20, par. 2, clause 1 of the Act on Karlsruhe Institute of Technology (KIT Act – KITG), as amended on July 14, 2009 (bulletin, p. 317 f.), last amended by Article 4 of the Act on the Change of State University Tuition Fees and Other Acts of May 09, 2017 (bulletin pp. 245, 250), and Article 32, par. 3, clause 1 of the Act of Baden-Württemberg on Universities and Colleges (Landeshochschulgesetz – LHG) of January 01, 2005 (bulletin, p. 1 f.), last amended by the Act on the Change of State University Tuition Fees and Other Acts of May 09,2017 (bulletin pp. 245, 250), the Senate of KIT adopted the following Studies and Examination Regulations for the Master's Program of Materials Science and Engineering on June 19, 2017.

The President expressed his approval of the last amendment according to Article 20, par. 2, KITG in conjunction with Article 32, par. 3, clause 1, LHG on October 20, 2021.

Contents

Preamble

Within the framework of the implementation of the Bologna process for establishment of a European higher education area, it is the declared objective of KIT that higher education at KIT should be completed by a master's degree. KIT therefore understands the consecutive bachelor's and master's programs offered to represent an integrated concept with a consecutive curriculum.

I. General Provisions

Article 1 – Scope

The present master's examination regulations shall cover the course of studies, examinations, and graduation in the Master's Program of Materials Science and Engineering at KIT.

Article 2 – Objective of Studies, Academic Degree

(1) During the consecutive master's program, scientific qualifications acquired in the course of the bachelor's program shall be further enhanced, expanded, extended, or complemented. Having completed the studies, the student shall be able to independently apply scientific findings and methods and to evaluate their significance and applicability to the solution of complex scientific and social problems.

(2) Upon successful completion of the master's examination, the academic degree of "Master of Science" (abbreviated by "M.Sc.") shall be conferred for the Master's Program of Materials Science and Engineering.

Article 3 – Regular Period of Studies, Organization of Studies, Credits

(1) The regular period of studies shall be four semesters.

(2) The curriculum of the program is divided into subjects, the subjects into modules, and the modules are divided into courses. The subjects and their scopes are defined in Article 19. Details are outlined in the module manual.

(3) The work expenditure envisaged for passing courses and modules is expressed in credits. The criteria for assigning credits correspond to the European Credit Transfer System (ECTS). One credit corresponds to a work expenditure of about 30 hours. As a rule, the credits shall be distributed equally over the semesters.

(4) The coursework and examinations required for the successful completion of the studies are measured in credits and amount to a total of 120 credits.

(5) The courses may be offered in the German and English languages.

Article 4 – Module Examinations, Coursework and Examinations

(1) The master's examination shall consist of module examinations. Module examinations shall consist of one or several controls of success. Controls of success shall consist of coursework and examinations.

(2) Examinations are:
1. Written examinations,
2. oral examinations, or
3. examinations of another type.

(3) Coursework shall be written, oral, or practical work that is usually accomplished by students parallel to the courses. The master's examination must not be completed by a coursework.

(4) At least 70% of the module examinations shall be graded.

(5) In case of complementary contents, module examinations of several modules may be replaced by a module-overlapping examination (par. 2, nos. 1-3).

Article 5 – Registration for and Admission to Module Examinations and Courses

(1) To participate in module examinations, students shall register online on the Students Portal for the corresponding controls of success. In exceptional cases, registration can be made in writing with the Students Office or another institution authorized by the latter. For controls of success, registration deadlines may be specified by the examiners. Registration of the master's thesis is outlined in the module manual.

(2) For admission to an examination in a certain module of choice, students, prior to the first examination in this module, shall submit together with their registration for the examination a binding declaration relating to their choice of the module and its assignment to a subject. At the request of the student to the examination committee, the choice or assignment can be changed later on.

(3) Admission to a control of success shall be granted to students, who
1. are enrolled in the Master's Program of Materials Science and Engineering at KIT, with the admission of students on leave being limited to examinations, and to students, who
2. can prove that they meet the requirements for admission to a control of success outlined in the module manual and
3. can prove that their entitlement to an examination in the Master's Program of Materials Science and Engineering has not been lost, and
4. meet the requirement outlined in Article 19a.

(4) According to Article 30, par. 5, LHG, admission to individual mandatory courses may be restricted. The examiner shall decide on the selection of students, who have registered in due time before the deadline given by the examiner, taking into account the study progress made by these students and taking into consideration Article 13, par. 1, clauses 1 and 2, if the surplus of registrations cannot be reduced by other or additional courses. In the case of identical study progress, further criteria shall be specified by the KIT Departments. The result shall be announced to the students in due time.

(5) Admission shall be refused, if the conditions outlined in pars. 3 and 4 are not fulfilled. Admission may be refused, if the corresponding control of success was already passed in a KIT bachelor's program that was required for admission to this Master's Program. This shall not apply to premature master's examinations. Admission to these shall be approved explicitly according to clause 1.

Article 6 – Execution of Controls of Success

(1) Controls of success shall be performed parallel to the studies, usually while imparting the contents of the individual modules or shortly afterwards.

(2) The type of control of success (Article 4, par. 2, nos. 1 - 3, par. 3) shall be specified by the examiner of the respective course depending on the contents of the course and teaching objectives of the module. The type of controls of success, their frequency, sequence, weighting, and the determination of the module grade, if applicable, shall be announced in the module manual six weeks prior to the start of the lecturing period at the latest. The examiner and student may agree on a change of the type of examination and the examination language later on. In the former case, Article 4, par. 4 shall be observed. When organizing examinations, the needs of students with a disability or chronic disease shall be considered according to Article 13, par. 1. Article 13, par. 1, clauses 3 and 4 shall apply accordingly.

(3) In case of an unreasonably high examination expenditure, a written examination may also be passed orally or an oral examination may also be passed in writing. This modification shall be announced six weeks prior to the examination at the latest.

(4) In case of courses in the English language (Article 3, par. 5), the corresponding controls of success shall be executed in this language. Article 6, par. 2 shall apply accordingly.

(5) *Written examinations* (Article 4, par. 2, no. 1) shall usually be evaluated by an examiner according to Article 18, par. 2 or par. 3. If an evaluation is made by several examiners, the grade shall be the arithmetic mean of the individual evaluations. If the arithmetic mean does not correspond to any of the grade levels defined in Article 7,

par. 2, clause 2, the grade shall be rounded to the next higher or lower grade level. In case of equal distance to the next higher and lower levels, the grade shall be rounded to the next higher grade level. The evaluation procedure shall not exceed six weeks. Written examinations shall last at least 60 and not more than 300 minutes.

(6) *Oral examinations* (Article 4, par. 2, no. 2) shall be performed and evaluated as group or individual examinations by several examiners (examining board) or by one examiner in the presence of an associate. Prior to determining the grade, the examiner shall consult the other examiners of the examining board. Oral examinations shall usually last at least 15 minutes and not more than 60 minutes per student.

Major details and results of the *oral examination* shall be documented in the minutes. The result of the examination shall be announced to the student directly after the oral examination.

Students, who intend to take the same examination in a later semester, shall be admitted to oral examinations as an audience depending on the space available and upon approval of the examinee. They shall not be admitted to the consultation of the examining board and announcement of the examination results.

(7) For *examinations of another type* (Article 4, par. 2, no. 3), appropriate deadlines and submission dates shall be specified. Proper description of the task and adequate documentation shall ensure that the examination passed can be credited to the student. Major details and results of the control of success shall be recorded in the minutes.

During *oral examinations of another type*, an associate shall be present in addition to the examiner, who shall also sign the minutes together with the examiner.

Theses or papers to be written for *an examination of another type* shall be provided with the following declaration: “Ich versichere wahrheitsgemäß, die Arbeit selbstständig angefertigt, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde.” (I herewith declare that the present thesis/paper is original work written by me alone and that I have indicated completely and precisely all aids used as well as all citations, whether changed or unchanged, of other theses and publications). If the thesis/paper does not contain this declaration, it shall not be accepted. Major details and results of such a control of success shall be recorded in the minutes.

Article 6 a – Controls of Success by a Multiple Choice Test

It is outlined in the module manual whether and to what an extent controls of success can be made by a *multiple choice test*.

Article 6 b – Computer-based Controls of Success

(1) Controls of success can be carried out in a computer-based way. In this case, the reply or solution of the student is transmitted electronically and, if possible, evaluated automatically. The examination contents shall be generated by an examiner.

(2) Prior to the computer-based control of success, the examiner shall ensure that the electronic data can be identified clearly and allocated unambiguously and permanently to the student. A trouble-free computer-based control of success shall be guaranteed by the corresponding technical support. In particular, the control of success shall be carried out in the presence of a competent person. All examination tasks must be available for work by the examinee during the entire examination period.

(3) As for the rest, the execution of computer-based controls of success shall be subject to Articles 6 and 6a.

Article 7 – Evaluation of Coursework and Examinations

(1) The result of an examination shall be specified by the examiners in the form of a grade.

(2) The following grades shall be used:

sehr gut (very good) for an outstanding performance;

gut (good)	for a performance that is far above the average;
befriedigend (satisfactory)	for a performance meeting average requirements;
ausreichend (sufficient)	for a performance that is still acceptable in spite of its deficiencies;
nicht ausreichend (failed)	for a performance that is no longer acceptable due to major deficiencies.

For the differentiated evaluation of individual examinations, the following grades shall be applied exclusively:

1.0, 1.3	“sehr gut” (very good),
1.7, 2.0, 2.3	“gut” (good),
2.7, 3.0, 3.3	“befriedigend” (satisfactory),
3.7, 4.0	“ausreichend” (sufficient), and
5.0	“nicht ausreichend” (failed).

(3) Coursework shall be evaluated with “bestanden” (passed) or “nicht bestanden” (failed).

(4) When determining the weighted means of module grades, subject grades, and the total grade, only the first decimal place shall be considered. All following decimal places shall be deleted without rounding.

(5) Every module and control of success may only be credited once in the same program.

(6) An examination shall be passed, if the grade is at least “ausreichend” (4.0, sufficient).

(7) A module examination shall be passed, if all required controls of success are passed. The module examination and determination of the module grade shall be outlined in the module manual. If the module manual does not contain any regulation about the determination of the module grade, the module grade shall be calculated

from the grade average weighted according to the credits of the individual partial modules. The differentiated grades (par. 2) shall be used for calculating the module grades.

(8) The results of the controls of success as well as the credits acquired shall be administrated by the Students Office of KIT.

(9) The grades of the modules of a subject shall be considered proportionally to the credits assigned to the modules when calculating the subject grade.

(10) The total grade of the master’s examination, the subject grades, and the module grades are:

Down to 1.5	“sehr gut” (very good),
from 1.6 to 2.5	“gut” (good),
from 2.6 to 3.5	“befriedigend” (satisfactory),
from 3.6 to 4.0	“ausreichend” (sufficient).

Article 8 – Repetition of Examinations, Ultimate Failure

(1) Students may repeat once a written examination that has not been passed (Article 4, par. 2, no. 1). In case a repeated written examination is given the grade of “nicht ausreichend” (5.0, failed), an oral reexamination shall take place soon after the date of the failed examination. In this case, the grade of this examination may not be better than “ausreichend” (4.0, sufficient).

(2) Students may repeat once an oral examination that has not been passed (Article 4, par. 2, no. 2).

(3) Repeated examinations according to paragraphs 1 and 2 shall correspond to the first examination in terms of contents, scope, and type (oral or written). At request, exceptions may be approved by the responsible examination committee.

(4) Examinations of another type (Article 4, par. 2, no. 3) can be repeated once.

(5) Coursework can be repeated several times.

(6) An examination shall ultimately not be passed, if an oral reexamination according to par. 1 was evaluated with the grade of “nicht ausreichend” (5.0, failed). The examination also shall ultimately not be passed, if the oral examination according to par. 2 or the examination of another type according to par. 4 was evaluated twice with the grade of “nicht bestanden” (failed).

(7) The module shall ultimately not be passed, if an examination required for passing the module is ultimately not passed.

(8) A second repetition of the same examination according to Article 4, par. 2 shall be possible in exceptional cases at the request of the student only (“Antrag auf Zweitwiederholung” – application for a second repetition). As a rule, the request shall be submitted in writing to the examination committee within two months upon announcement of the grade.

The examination committee shall decide on the first application of a student for a second repetition. If the examination committee dismisses the application, a member of the Executive Board shall decide. Upon comment of the examination committee, a member of the Executive Board shall decide on further applications for a second repetition. If the application is accepted, the second repetition shall take place on the next but one examination date at the latest. Paragraph 1, clauses 2 and 3 shall apply accordingly.

(9) Repetition of a passed examination shall not be permitted.

(10) In case a master’s thesis has been granted the grade “nicht ausreichend” (5.0, failed), it can be repeated once. A second repetition of the master’s thesis shall be excluded.

Article 9 – Loss of the Entitlement to an Examination

In case coursework or an examination required according to the present Studies and Examination Regulations is ultimately not passed or the master's examination, including potential repetitions, is not passed completely by the end of the examination period of the seventh semester, the entitlement to examination in the Master's Program of Materials Science and Engineering shall expire, unless the student is not responsible for having exceeded the deadline. The decision on extending the deadline and on exceptions from the deadline regulations shall be made by the examination committee taking into account the activities listed in Article 32, par. 6, LHG at the request of the student. This request shall be made in writing usually six weeks prior to the expiry of the deadline.

Article 10 – Deregistration, Absence, Withdrawal

(1) Students can revoke their registration for *written examinations* until the issue of the examination tasks without having to indicate any reasons (deregistration). Deregistration can be made online on the Students Portal by 12 pm on the day before the examination or in justified exceptional cases with the Students Office during office hours. If the deregistration is addressed to the examiner, the latter shall ensure that the deregistration is documented in the Campus Management System.

(2) In case of *oral examinations*, deregistration shall be declared to the examiner at least three working days before the date of examination. Withdrawal from an oral examination less than three working days before the date of examination shall be possible under the conditions outlined in par. 5 only. In principle, withdrawal from oral reexaminations in the sense of Article 9, par. 1 shall be possible under the conditions of par. 5 only.

(3) Deregistration from *examinations of another type* and from *coursework* shall be subject to the provisions given in the module manual.

(4) A control of success shall be deemed to have been "nicht ausreichend" (5.0, failed), if students fail to be present at the examination without a good reason or if they withdraw from the control of success after its start without a good reason. The same

shall apply, if the master’s thesis is not submitted within the period envisaged, unless the student is not responsible for having exceeded the deadline.

(5) The reason given for withdrawal after the start of the control of success or absence shall be notified immediately, credibly, and in writing to the examination committee. In case of sickness of the student or of a child maintained by the student alone or of a relative in need of care, submission of a medical certificate may be required.

Article 11 – Deception, Breach of Regulations

(1) In case students try to influence the result of their control of success by deception or the use of impermissible aids, this control of success shall be deemed to have been “nicht ausreichend” (5.0, failed).

(2) Students disturbing the proper execution of the control of success may be excluded from the continuation of this control of success by the examiner or supervisor. In this case, the control of success shall be deemed to have been “nicht ausreichend” (5.0, failed). In serious cases, the examination committee can exclude these students from other controls of success.

(3) Details relating to honesty during examinations and internships are outlined in the General Statutes of KIT, as amended.

Article 12 – Maternity Protection, Parental Leave, Assumption of Family Obligations

(1) The provisions given in the Act on the Protection of Mothers at Work, during Education, and during Studies (Mutterschutzgesetz - MuSchG), as amended, shall apply. The maternity protection periods suspend any deadline according to the present examination regulations. The duration of maternity protection shall not be included in the deadline given.

(2) In addition, the deadlines of parental leave shall be considered according to the valid legislation (Bundeselterngeld- und Elternzeitgesetz (Parental Benefit and

Parental Leave Act - BEEG)) at the student's request. Four weeks prior to the desired start of the parental leave period at the latest, the student shall inform the examination committee in writing about the time when she/he wishes to be on parental leave, with the required evidence being enclosed. The examination committee shall then check whether the legal prerequisites would justify an employee's claim for parental leave and inform the student immediately of the result and the new times of examination. The period of work on the master's thesis may not be interrupted by parental leave. In this case, the thesis shall be deemed to have not been assigned. Upon expiry of the parental leave period, the student shall receive a new subject that is to be dealt with within the period defined in Article 14.

(3) At request, the examination committee shall decide on the flexible handling of examination deadlines according to the provisions of the Act of Baden-Württemberg on Universities and Colleges (LHG), if students have to assume family obligations. Paragraph 2, clauses 4 to 6 shall apply accordingly.

Article 13 – Students with a Disability or Chronic Disease

(1) When organizing studies and examinations, the needs of students with a disability or chronic disease shall be considered. In particular, students with a disability or chronic disease shall be granted preferred access to courses with a limited number of participants and the order for passing certain courses shall be adapted to their needs. According to the Federal Equality Act (Bundesgleichstellungsgesetz, BGG) and Vol. 9 of the Social Code (SGB IX), students are disabled, if their bodily function, mental capacity, or emotional health most probably deviates from the state typical of the age for a period longer than six months and, hence, their participation in social life is impaired. At the request of the student, the examination committee shall decide on the existence of conditions outlined in clauses 2 and 3. The student shall submit the required evidence for this purpose.

(2) If students provide evidence of a disability or chronic disease, as a result of which they are not able to pass controls of success completely or partly within the planned time or in the form envisaged, the examination committee may permit controls of

success within other time periods or in another form. In particular, students with a disability or chronic disease shall be permitted to use the required aids.

(3) In case students provide evidence of a disability or chronic disease, as a result of which they are not able to attend courses regularly or to pass the required coursework or examinations as outlined in Article 19, the examination committee may permit at the student's request passing of certain coursework and examinations after the expiry of the deadlines given in the present Studies and Examination Regulations.

Article 14 – Master's Thesis Module

(1) For admission to the master's thesis module, the module examinations in the amount of 75 credits must have been passed successfully. At the request of the student, the examination committee shall decide on exceptions.

(1a) 30 credits are assigned to the master's thesis module. It consists of the master's thesis and a public presentation. The presentation shall be made within a period of four weeks upon submission of the master's thesis.

(2) The master's thesis can be assigned by university teachers, executive scientists according to Article 14, par. 3, cl. 1, KITG, and habilitated members of the KIT Department of Mechanical Engineering. In addition, the examination committee can authorize other examiners to assign the subject according to Article 17, pars. 2 and 3. The students shall be given the possibility of making proposals relating to the subject. If the master's thesis is to be written outside of the KIT Departments of Mechanical Engineering, Chemistry and Biosciences, Chemical and Process Engineering, Electrical Engineering and Information Technology, or Physics, the approval of the examination committee shall be required. The master's thesis may also be accepted in the form of group work, if the contributions of the individual students to be evaluated in the examination can be distinguished clearly based on objective criteria and if the requirement outlined in par. 4 is fulfilled. In exceptional cases, the chairperson of the examination committee shall take care of the student receiving a subject for the master's thesis within four weeks upon her/his request. In this case, the subject is issued by the chairperson of the examination committee.

(3) The subject, task, and scope of the master's thesis shall be limited by the supervisor such that it can be handled with the expenditure outlined in par. 4.

(4) The master's thesis shall demonstrate that the students are able to deal with a problem of their subject area in an independent manner and within a limited period of time using scientific methods. The scope of the master's thesis shall correspond to 30 credits. The maximum duration of work on the thesis shall amount to six months. The subject and task shall be adapted to the scope envisaged. The examination committee shall specify the languages in which the master's thesis can be written. At the request of the student, the examiner can permit the master's thesis to be written in a language other than German or English.

(5) When submitting the master's thesis, the students shall assure in writing that the thesis is original work by them alone and that they have used no sources and aids other than indicated, marked all citations in word and content, and observed the Statutes of KIT for Safeguarding Good Scientific Practice, as amended. If this declaration is not contained, the thesis will not be accepted. The wording of the declaration may be: "Ich versichere wahrheitsgemäß, die Arbeit selbständig verfasst, alle benutzten Hilfsmittel vollständig und genau angegeben und alles kenntlich gemacht zu haben, was aus Arbeiten anderer unverändert oder mit Abänderungen entnommen wurde sowie die Satzung des KIT zur Sicherung guter wissenschaftlicher Praxis in der jeweils gültigen Fassung beachtet zu haben." (I herewith declare that the present thesis is original work written by me alone and that I have indicated completely and precisely all aids used as well as all citations, whether changed or unchanged, of other theses and publications, and that I have observed the Statutes of KIT for Safeguarding Good Scientific Practice, as amended).
If the declaration is found to be not true, the master's thesis shall be evaluated "nicht ausreichend" (5.0, failed).

(6) The time of assignment of the subject of the master's thesis shall be recorded by the supervisor and the student/s and documented in the files of the examination committee. The time of submission of the master's thesis shall be recorded in the files of the examination committee by the examiner. The student shall be allowed to return

the subject of the master’s thesis once only within the first month of the period of work on the thesis. At the justified request of the student, the examination committee may extend the time of work on the thesis given in par. 4 by three months at the maximum. If the master’s thesis is not submitted in time, it shall be deemed to have been “nicht ausreichend” (5.0, failed), unless the student is not responsible for this failure.

(7) The master’s thesis shall be evaluated by a university teacher, an executive scientist according to Article 14, par. 3, cl. 1, KITG, or a habilitated member of the KIT Department of Mechanical Engineering and another examiner at least. As a rule, one of the examiners is the person who assigned the thesis according to par. 2. In case of deviating evaluations of both persons, the examination committee shall fix the grade of the master’s thesis within the limits of the evaluations of both persons. It may also appoint another expert. The evaluation period shall not exceed eight weeks upon submission of the master’s thesis.

Article 14 a – Internship

(1) During the master’s program, an internship of at least nine weeks must be passed, which is suited to give the students an idea of professional work in the area of Materials Science and Engineering. The internship is assigned 12 credits.

(2) In their own responsibility, the students shall contact appropriate private or public institutions, where the internship may be passed. Details are outlined in the module manual.

Article 15 – Additional Achievements

(1) Further credits (additional achievements) in the amount of 30 credits at the maximum may be acquired in the courses offered by KIT. Articles 3 and 4 of the examination regulations shall remain unaffected. These additional achievements shall not be considered when calculating the total and module grades. The credits not considered when determining the module grade shall be listed and marked as additional achievements in the transcript of records. At the student’s request, additional achievements shall be indicated in the master’s certificate and marked as additional

achievements. Additional achievements shall be listed with the grades outlined in Article 7.

(2) The students shall declare a module examination an additional achievement when registrating for this examination already.

Article 15a – Transferable Skills

Apart from scientific qualifications, KIT attaches high importance to transferable skills. These transferable skills of 4 credits shall be part of the Master's Program of Materials Science and Engineering. Transferable skills may be imparted additively or integratively.

Article 16 – Examination Committee

(1) For the Master's Program of Materials Science and Engineering, an examination committee shall be formed. It shall consist of 4 members entitled to vote, 2 university teachers/executive scientists according to Article 14, par. 3, cl. 1, KITG/assistant professors and two academic staff members according to Article 52, LHG/scientific staff members according to Art. 14, par. 3, cl. 2, KITG, as well as one student with an advisory vote. In case of the establishment of a joint examination committee for the Bachelor's and Master's Programs of Materials Science and Engineering, the number of students is increased to two members with an advisory vote, with one of them coming from the bachelor's program and one from the master's program. The term of office of the non-student members shall be two years, the term of office of the student member shall be one year.

(2) The chairperson, her/his deputy, the other members of the examination committee, and their deputies shall be appointed by the KIT Department Council. The members of the group of academic staff according to Article 52, LHG, the scientific staff members according to Article 14, par. 3, cl. 2, KITG, and the students shall be proposed by the members of the respective groups. Reappointment shall be possible. The chairperson and her/his deputy shall be university teachers or executive scientists according to Article 14, par. 3, cl. 1, KITG. The chairperson of the examination committee shall be

responsible for current transactions and supported by the respective examination office.

(3) The examination committee shall take care of the provisions of the present Studies and Examination Regulations being observed and shall decide on examination matters. It shall decide on the recognition of study periods, coursework, and examinations according to Article 18, par. 1, cl. 1. It shall regularly report to the KIT Department about the development of examination and study periods as well as about the times of work on the master's theses and the distribution of module and total grades. It shall make suggestions for reforms of the Studies and Examination Regulations and module descriptions. The examination committee shall decide with the majority of its votes. In the case of a split vote, the chairperson of the examination committee shall decide.

(4) The examination committee may delegate the execution of its tasks for all standard cases to its chairperson. In urgent cases that cannot be postponed until the next meeting of the examination committee, the chairperson of the examination committee shall decide.

(5) The members of the examination committee shall have the right to participate in examinations. The members of the examination committee, the examiners, and the associates shall be obliged to secrecy. If they do not work in the public service sector, they shall be obliged to secrecy by the chairperson.

(6) In matters of the examination committee, which are related to an examination to be passed at another KIT Department, a competent person authorized to examine and to be appointed by the respective KIT Department shall be consulted at the request of a member of the examination committee.

(7) The student shall be informed in writing about incriminating decisions by the examination committee. These decisions shall be justified and provided with an information on legal remedies available. Prior to a decision, the student shall be given the opportunity to comment. Objections against decisions made by the examination committee shall be made to the examination committee within one month upon receipt

of the decision. In case of objections, the executive board member responsible for higher education shall decide.

Article 17 – Examiners and Associates

(1) The examination committee shall appoint the examiners. It may transfer this task to its chairperson.

(2) Examiners shall be university teachers and executive scientists according to Article 14, par. 3, cl. 1, KITG, habilitated members, and academic staff members according to Article 52, LHG from the respective KIT Department, who have been authorized to examine students; scientific staff members according to Article 14, par. 3, cl. 2, KITG may also be authorized to examine. For appointment as examiner, persons shall have the scientific qualification corresponding to the examination subject at least.

(3) If courses are held by persons other than those mentioned in par. 2, these shall be appointed examiners, if they have the scientific qualification required in par. 2, cl. 2. External persons may also be appointed examiners of a master's thesis, provided that they can prove that they have the qualification outlined in par. 2, cl. 2.

(4) Associates shall be appointed by the examiners. Persons having completed a master's program of mathematics, natural sciences, or engineering sciences or having an equivalent academic degree only may be appointed associate.

Article 18 – Recognition of Coursework and Examinations as well as of Study Periods

(1) Coursework and examinations made as well as study periods passed in study programs at state or state-recognized universities and cooperative state universities of the Federal Republic of Germany or at foreign state or state-recognized universities shall be recognized at the request of the students, if the competences acquired do not differ considerably from the achievements or degrees to be replaced. For this, no schematic comparison, but an overall analysis shall be made. As regards the scope of

a coursework or examination to be recognized, the principles of the ECTS shall be applied.

(2) The students shall submit the documents required for recognition. Students newly enrolled in the Master's Program of Materials Science and Engineering shall submit the application together with the documents required for recognition within one semester upon enrollment. If documents are not available in the German or English language, an officially certified translation may be requested. The examination committee shall bear the burden of proving that the application does not meet the recognition requirements.

(3) If achievements not made at the KIT are recognized, they are listed as “anerkannt” (recognized) in the certificate. If grades exist, they shall be taken over in case of comparable grade scales and shall be included in the calculation of module grades and the total grade. In case of incomparable grade systems, the grades can be converted. In the absence of grades, the note “bestanden” (passed) shall be entered.

(4) When recognizing coursework and examinations passed outside of the Federal Republic of Germany, the equivalence agreements adopted by the Conference of Ministers of Education and the German Rectors' Conference as well as agreements concluded within the framework of university partnerships shall be considered.

(5) Knowledge and skills acquired outside of the university system shall be recognized, if they are equivalent to the coursework and examinations to be replaced in terms of contents and level and if the institution, where the knowledge and skills were acquired, has a standardized quality assurance system. Recognition may be refused in parts, if more than 50% of the university's study program are to be replaced.

(6) The examination committee shall be responsible for recognitions. To determine whether a considerable difference in the sense of par. 1 exists, the responsible subject representatives shall be heard. Depending on the type and scope of coursework and examinations to be recognized, the examination committee shall decide on admission to a higher semester.

II. Master's Examination

Article 19 – Scope and Type of the Master's Examination

(1) The master's examination shall consist of the module examinations according to par. 2 and the master's thesis module (Article 14) as well as the internship (Article 14a).

(2) Module examinations shall be passed in the following mandatory subjects:

1. Materials science specialization: Module(s) in the amount of 30 credits
2. Focus I: Module(s) in the amount of 16 credits
3. Focus II: Module(s) in the amount of 16 credits
4. Interdisciplinary complementary course(s): Module(s) in the amount of 12 credits
5. Transferable skills: Module(s) in the amount of 4 credits according to Art. 15a.

The modules available for selection and their allocation to subjects shall be specified in the module manual.

Article 19a – Certificates of Achievements for the Master's Examination

Registration for the last module examination of the master's examination procedure requires the certificate of a successfully passed internship according to Article 14a. In exceptional cases for which the students are not responsible, the examination committee may permit later submission of this certificate.

Article 20 – Passing of the Master's Examination, Calculation of the Total Grade

(1) The master's examination shall be passed, if all module examinations mentioned in Article 19 were evaluated with the grade "ausreichend" (sufficient) at least and all achievements listed in Article 19 were passed.

(2) The total grade of the master's examination shall be the mean of the subject grades and the master's thesis module weighted with the credits.

(3) In case the students have completed the master's thesis with the grade 1.0 and the master's examination with an average of 1.2 or better, the predicate "mit Auszeichnung" (with distinction) shall be granted.

Article 21 – Master's Transcript, Master's Certificate, Diploma Supplement, and Transcript of Records

(1) Upon evaluation of the last examination, a master's certificate and a transcript shall be issued about the master's examination not later than three months upon the last examination. The master's certificate and transcript shall be issued in the German and English languages. The master's certificate and transcript shall bear the date of the successful passing of the last examination. They shall be handed over to the students together. The master's certificate shall document conferral of the academic master's degree. The master's certificate shall be signed by the President and the KIT Dean of the KIT Department and provided with the seal of KIT.

(2) The transcript shall list the subject and module grades, the credits assigned to the modules and subjects, and the total grade. If a differentiated evaluation of individual examinations was made according to Article 7, par. 2, cl. 2, the respective decimal grade shall be indicated in the transcript. Article 7, par. 4 shall remain unaffected. The transcript shall be signed by the KIT Dean of the KIT Department and the chairperson of the examination committee.

(3) In addition, the students shall be given a diploma supplement in the German and English languages, which corresponds to the requirements of the applicable ECTS Users' Guide, as well as a transcript of records in German and English.

(4) The transcript of records shall list all coursework and examinations passed by the student in a structured form. It shall include all subjects and subject grades as well as the assigned credits, the modules assigned to the respective subject with the module grades and the credits assigned, as well as the controls of success assigned to the modules together with the grades and the credits. Paragraph 2, cl. 2 shall apply accordingly. The transcript of records shall clearly reflect the assignment of controls of success to the individual modules. Recognized coursework and examinations shall be

included in the transcript of records. All additional achievements shall be listed in the transcript of records.

(5) The master's certificate, master's transcript, and the diploma supplement, including the transcript of records, shall be issued by the Students Office of the KIT.

III. Final Provisions

Article 22 – Certificate of Examination Achievements

In case students have ultimately failed in the master's examination, they shall be given at request and against submission of the exmatriculation certificate a written certificate about the coursework and examinations made, the respective grades, as well as the confirmation that the overall examination has not been passed. The same shall apply when the entitlement to an examination has expired.

Article 23 – Deprivation of the Master's Degree

(1) If students have been guilty of deception during an examination and if this fact becomes known upon the hand-over of the certificates only, the grades of the module examinations, during which the students were guilty of deception, can be corrected. If applicable, this module examination may be declared to have been "nicht ausreichend" (5.0, failed) and the master's examination may be declared to have been "nicht bestanden" (failed).

(2) If the conditions for admission to an examination were not fulfilled without the student wanting to deceive and if this fact becomes known upon the hand-over of the certificate only, this default shall be remedied by the passing of the examination. If the student intentionally and wrongly obtained admission to the examination, the module examination may be declared to have been "nicht ausreichend" (5.0, failed) and the master's examination may be declared to have been "nicht bestanden" (failed).

(3) Prior to a decision of the examination committee, the student shall be given the opportunity to comment.

(4) The incorrect certificate shall be confiscated and, if applicable, a new certificate shall be issued. Together with the incorrect certificate, the master's certificate shall also be confiscated, if the master's examination was declared to have been "nicht bestanden" (failed) due to a deception.

(5) A decision pursuant to par. 1 and par. 2, cl. 2 shall be excluded after a period of five years upon the date of issue of the certificate.

(6) Deprivation of the academic degree shall be subject to Article 36, par. 7, LHG.

Article 24 – Inspection of Examination Files

(1) Upon completion of the master's examination, the students shall be granted the right to inspect the examination copy of their master's theses, the related opinions, and minutes of the examinations within one year at request.

(2) For inspection of the written module examinations, written module part examinations, and examination minutes, a deadline of one month after announcement of the examination result shall apply.

(3) The examiner shall determine the place and time of inspection.

(4) Examination documents shall be kept for at least five years.

Article 25 – Entry into Force, Transition Regulations

(1) The present Studies and Examination Regulations shall enter into force on October 01, 2017 and shall apply to

1. students who start studies within the Master's Program of Materials Science and Engineering at KIT in the first semester and to
2. students who start their studies within the Master's Program of Materials Science and Engineering at KIT in a higher semester, provided that this semester does not exceed the semester reached by the first year according to cl. 1.

(2) The Studies and Examination Regulations for the Master's Program of Materials Science and Engineering (MWT) of June 30, 2011 (Official Announcement of KIT No. 38 of June 30, 2011), as amended by the Statutes for Implementation of the Convention on the Recognition of Qualifications Concerning Higher Education in the European Region of April 11, 1997 (Lisbon Convention) according to Articles 32, pars. 2, 4 and 36a, LHG in the Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) dated March 27, 2014 (Official Announcement of KIT No. 19 of March 28, 2014) shall remain valid for

1. students who last started their studies within the Master's Program of Materials Science and Engineering at KIT in the summer semester 2017 as well as for
2. students who start their studies within the Master's Program of Materials Science and Engineering at KIT in a higher semester as of the 2017/18 winter semester, if the higher semester exceeds the semester reached by the first year according to par. 1, cl. 1.

As for the rest, the above Studies and Examination Regulations cease to be in force.

(3) Students who started their studies at KIT based on the Studies and Examination Regulations of KIT for the Master's Program of Materials Science and Engineering (MWT) of June 30, 2011 (Official Announcement of KIT No. 38 of June 30, 2011), as amended by the Statutes for Implementation of the Convention on the Recognition of Qualifications Concerning Higher Education in the European Region of April 11,1997 (Lisbon Convention) according to Articles 32, pars. 2, 4 and 36a LHG in the Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) dated March 27, 2014 (Official Announcement of KIT No. 19 of March 28, 2014) may pass examinations based on these Studies and Examination Regulations until the end of the examination period of the 2022 summer semester for the last time.

(4) Article 15, par. 2 of the Studies and Examination Regulations of Karlsruhe Institute of Technology (KIT) for the Master's Program of Materials Science and Engineering of June 26, 2017 (Official Announcement of Karlsruhe Institute of Technology (KIT) No. 48 of June 27, 2017), last amended by Article 59 of the Statutes of September 03, 2020 (Official Announcement of Karlsruhe Institute of Technology (KIT) No. 49 of September 04, 2020) shall remain applicable until the end of the 2021/2022 winter

semester to students who started their studies in the Master's Program of Materials Science and Engineering prior to the 2022 summer semester.

Karlsruhe, October 20, 2021
Professor Dr.-Ing. Holger Hanselka
(President)